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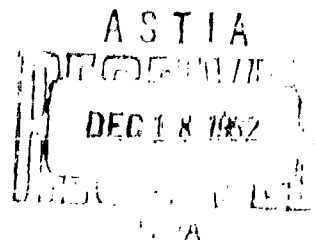
X-RAY ANTHROPOMETRY OF THE HAND

TECHNICAL DOCUMENTARY REPORT NO. AMRL-TDR-62-111

September 1962

Behavioral Sciences Laboratory
6570th Aerospace Medical Research Laboratories
Aerospace Medical Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

Contract Monitor: Charles E. Clauser
Project No. 7184, Task No. 71749



[Prepared under Contract No. AF 33(616)-6792
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291 412

FOREWORD

This report, X-Ray Anthropometry of the Hand, was prepared by Antioch College, Yellow Springs, Ohio, under Contract No. AF 33(616)-6792, Project No. 7184, "Human Performance in Advanced Systems," and Task No. 718408, "Anthropology for Design," under the direction of the Anthropology Section, Human Engineering Branch, 6570th Aerospace Medical Research Laboratories, Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio. Mr. Charles E. Clauser of the Anthropology Section served as contract monitor.

The 253 X-ray films used in this study were selected from a series of hand X-rays collected in 1955 as part of a comprehensive survey of hand dimensions initiated by Frank P. Saul, then of the Anthropology Section.

Dr. James T. Barter, then of the Anthropology Section, collected the first 100 X-rays of subjects at Wright-Patterson Air Force Base, measured the images, and developed a sizing system for pressure gloves (Barter and Alexander, ref 1.). To enlarge the sample, Mr. Saul arranged for X-ray photography of additional flying personnel at Lockbourne Air Force Base, Ohio. Mr. Edward I. Fry, then of Antioch College, collected enough additional films to bring the total to 411.

All of the 253 X-ray films selected from the total sample were completely measured by the author according to new standards, to the selection and definition of which Mr. Saul, Dr. Barter, Mr. Clauser and Mr. Fry all contributed.

The author is indebted to Mr. H. T. E. Hertzberg, Chief, Anthropology Section, for initiating the present survey of X-ray hand dimensions and for a critical review of the final manuscript, and to Mr. Clauser for his guidance throughout all phases of the work. The author is particularly grateful to Mr. Edmund Churchill, Director of the Anthropometric Project of Antioch College, and to Dr. Melvin J. Warrick, Assistant Chief of the Human Engineering Branch for their statistical advice, and to Mr. John T. McConville, also of Antioch, and to Dr. Barter, for his recent critical review of the manuscript and his many helpful comments and suggestions. The illustrations were prepared by M. J. Kennedy.

ABSTRACT

A comprehensive descriptive summary of the X-ray anthropometry of the hand is presented. The 253 subjects chosen for measurement were selected to be representative of the Air Force population in hand length and hand breadth. Summary statistics for 24 lengths and 20 breadths for both the left and the right hands are presented. Also included in the report are complete intercorrelation matrices for both hands indicating the degree of interrelationship between the 44 dimensions.

Analysis of the data indicates that, in general, the right hand tends to be longer and broader than the left, the right hand also showing slightly greater variability in length and less variability in breadth than the left. The lowest correlations occur in the relationships between length and breadth dimensions, and the highest are to be found within the length dimensions of each of the five digits.

PUBLICATION REVIEW

This technical documentary report has been reviewed and is approved.

Walter F. Grether
WALTER F. GRETHER
Technical Director
Behavioral Sciences Laboratory

TABLE OF CONTENTS

Section	Page
I Introduction	1
II Methods	3
III Sample Selection	12
IV Results and Discussion	22
V Summary	31
Bibliography	32
 APPENDICES	
I Index of Hand Dimensions	33
II Intercorrelation Matrices, Right and Left Hands	35

LIST OF FIGURES AND TABLES

Figure		
1	X-Ray Anatomy, the Right Hand	2
2	Tracing of X-Ray of Hand Illustrating Landmarks and Baselines Used in Measuring	4
3	Height of Metacarpal I	7
4	Height of Proximal Phalanx I	7
5	Height of Tip I	7
6	Height of Metacarpals II-V	8
7	Height of Proximal Phalanges II-V	8
8	Height of Middle Phalanges II-V	8
9	Height of Tips II-V	9
10	Height of Crotches I-IV	9
11	Height of Measured Hand Breadth	9
12	Hand Breadth	10
13	Wrist Breadth	10
14	Breadth at Base of Digits I-V	10

LIST OF FIGURES AND TABLES (Continued)

Figure		Page
15	Breadth of Proximal Knuckles II-V	11
16	Breadth of Distal Knuckles II-V, and Thickness of Distal Knuckle I	11
17	Vertical Baseline to Crotches I-IV	11
Table		
I	Comparison of Hand Lengths and Hand Breadths Between 1950 Survey Sample and Selected X-Ray Sample	13
II	Percentile Distribution of Hand Lengths, Right Hand	14
III	Percentile Distribution of Hand Breadths, Right Hand	15
IV	Percentile Distribution of Hand Lengths, Left Hand	16
V	Percentile Distribution of Hand Breadths, Left Hand	17
VI	Statistical Summary of Hand Lengths, Right Hand	18
VII	Statistical Summary of Hand Breadths, Right Hand	19
VIII	Statistical Summary of Hand Lengths, Left Hand	20
IX	Statistical Summary of Hand Breadths, Left Hand	21
X	Mean Coefficients of Correlation Per Dimension, Both Hands	24
XI	Right Minus Left Hand Comparisons, Lengths	26
XII	Right Minus Left Hand Comparisons, Breadths	28
XIII	Coefficients of Correlation Between Left and Right Hands	30

X-RAY ANTHROPOMETRY OF THE HAND

SECTION I

INTRODUCTION

Until recently, attempts to describe the hand in terms of its size and shape have been dependent upon direct measurement techniques (refs. 3, 5, 8, 9, 11, 12). The actual hand, not a tracing or an X-ray thereof, has been measured and the establishment of baselines and landmarks essential in the measuring process has been dependent upon specific features of surface anatomy. There are certain limitations to this approach, however. Only gross dimensions such as total lengths can be measured with any degree of reliability. For example, portions of the digits such as metacarpal or individual phalangeal lengths cannot be easily marked for measurement. Also, anatomical features of the skin surface, such as creases and folds, are often not distinct enough to serve as consistently reliable criteria for the establishment of reference points (ref. 2).

By contrast, the use of X-rays in any descriptive survey of hand size has a number of advantages. Landmarks based on bony configurations are more easily delineated and show greater consistency between individuals. Portions of the digits can be subjected to measurement, facilitating a more comprehensive survey of the entire hand. In addition, there are certain practical implications inherent in the use of X-rays. A relatively small amount of subject time is required and a permanent record is provided on which measurements can be made and rechecked immediately or at some future time.

The present study had been initiated in an effort to demonstrate the practicability of using hand X-rays for measurement, to expand the list of dimensions usually measured, and to serve as a reference text for future researchers concerned with the roentgenographic anthropometry of the hand. Sample selection has been carefully controlled to approximate the hand length and breadth parameters of the U. S. Air Force population (ref. 9) so that any attempt to combine the X-ray data with actual hand data, thus incorporating circumferences and depths with the linear dimensions, would be both feasible and operational.

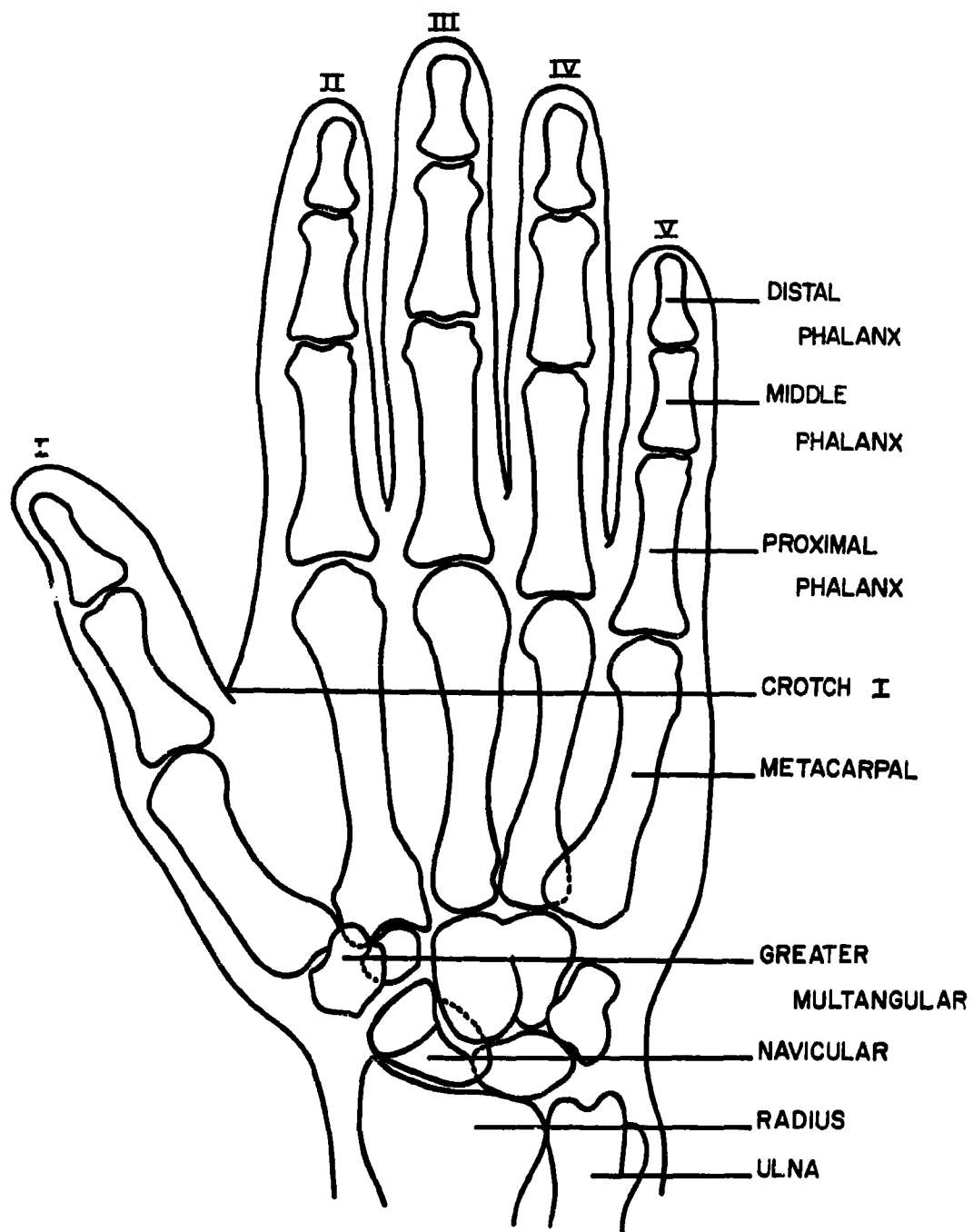


Figure 1. X-Ray Anatomy, the Right Hand.

SECTION II

METHODS

In 1955, the Anthropology Section at Wright-Patterson Air Force Base undertook an anthropometric survey of the hand combining both direct and X-ray measurements. Some of the data were utilized in the establishment of a glove sizing program (ref. 1). As part of the total survey, X-rays of both the left and right hands were obtained on a sample of 411 male personnel (Air Force, 91%; civilian, 9%) from Wright-Patterson and Lockbourne Air Force Bases. These X-rays provided the raw material for the present study.

Positioning of the subjects for exposure involved placement of the hand, palm down, on a 14" x 17" film holder in such a way that the forearm, hand and middle finger described a straight line (ref. 2). The fingers were extended and separated just enough to prevent contact, and the thumb was partially abducted. No strict controls on thumb positioning were specified at the time of exposure so that a certain amount of variability is to be found in the degree of abduction. Although X-rayed separately, the left and right hands were exposed on the same film. See Barter and Alexander (ref. 1) for an illustration of the actual procedure. All exposures were made at 50 KVP and 40 MA for 0.25 seconds with a constant tube-to-film distance of 38.75 inches. The films were developed for slightly greater than normal contrast to obtain good definition of both soft tissue and bony parts.

In the present study, all measurements were taken with a plastic ruler and readings were made to the nearest millimeter. The entire series of measurements was made by the author. Tests for intra-observer reliability indicated that a variation of plus or minus 1 millimeter could be expected on the basis of measuring error alone. Consideration was given to the possibility of defining a range of measuring error per dimension, but because measurements were taken only to the nearest millimeter, the method was considered unnecessary.

A reduction of 2 percent was applied to each measured value in order to adjust for X-ray image enlargement. This constant adjustment factor was derived by dividing tube-to-median plane distance by tube-to-film distance (ref. 10). Median plane is here defined as lying above the film plane by one-half the mean thickness of Metacarpale III as reported for the Air Force population (ref. 9). Barter and Alexander, in discussing direct application of their X-ray values, felt that adjustment was unnecessary "because the factor of compressibility of the flesh is non-existent" in X-ray measurement (ref. 1). However, in the present data, since a 2 percent reduction for the larger dimensions such as hand length amounted to differences as great as 4 millimeters, it was felt that adjustment was necessary. In any comparison of the present data with Barter and Alexander's X-ray data, this difference should be taken into account.

In the establishment of landmarks and baselines for use as reference points in the measuring process, an attempt was made to satisfy four conditions. The first of these was the practical necessity of approximating techniques used in direct hand measurement. Hand length, for example, in

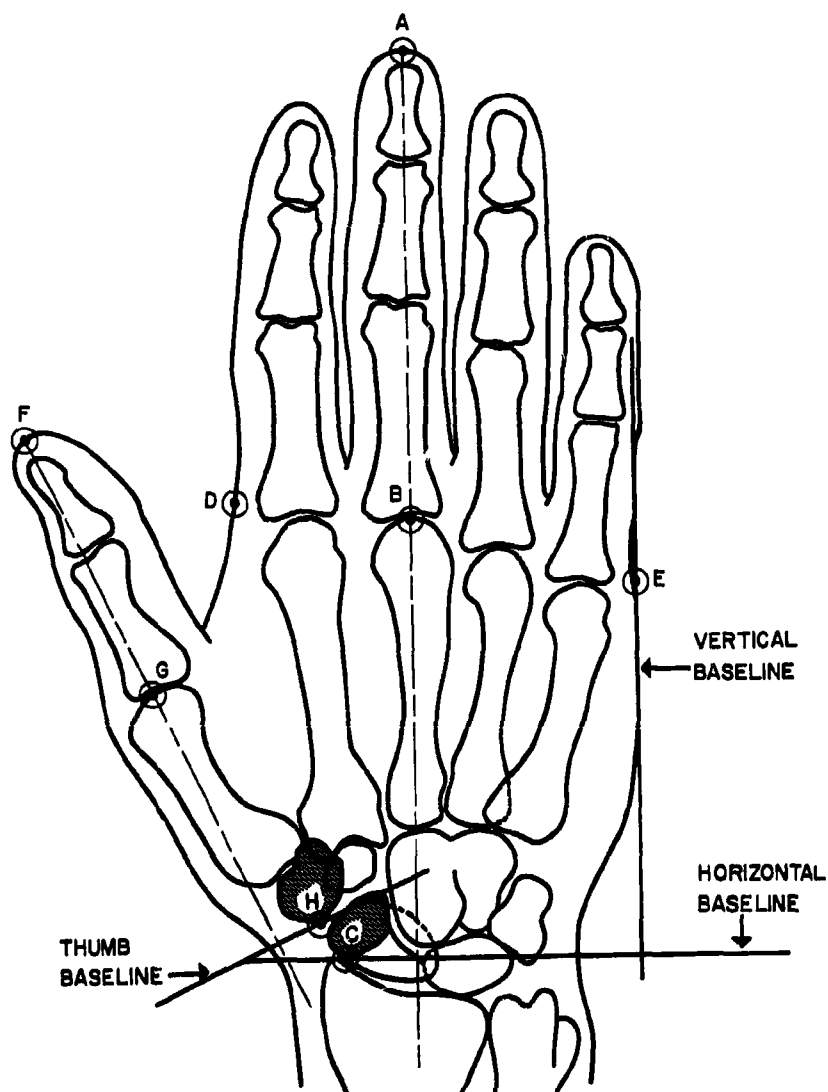


Figure 2. X-Ray Tracing of the Hand, Demonstrating Points and Baselines Used in the Measurement of Hand Dimensions.

- | | |
|--|--|
| <p>A. Midpoint of the fleshy tip of digit III</p> <p>B. Midpoint of the distal end of metacarpal III</p> <p>C. Most proximal point on the navicular tuberosity</p> <p>D. Point on fleshy margin at the radial side of the hand adjacent to the area of maximum outward flare of the proximal end of phalanx II</p> | <p>E. Point on fleshy margin at the ulnar side of the hand adjacent to the area of maximum outward flare of the proximal end of phalanx V</p> <p>F. Midpoint of the fleshy tip of digit I</p> <p>G. Midpoint of the distal end of metacarpal I</p> <p>H. Tubercle of the greater multangular</p> |
|--|--|

both the 1950 Anthropometric Survey of more than 4000 U. S. Air Force males (ref. 9) and Barter and Alexander's glove-sizing study (ref. 1), was measured directly. For any comparison of the present X-ray data with those of either of these surveys, the closest comparability in measurement technique was considered a necessity.

A second condition for consideration in the formulation of a roentgenographic measuring technique was the selection of baselines which would be least affected by inadvertent differences in positioning of the hand for exposure.

A third, of equal consideration, was the selection of baselines which would not be dependent upon bony landmarks susceptible to variation in anatomical configuration.

A final factor in the formulation of a measuring technique was the attempt to establish baselines which could be readily reproduced by future observers interested in the possibility of incorporating the present data into further investigations.

On the basis of these criteria, three baselines were established. These baselines, along with descriptions of each of the pertinent landmarks, are presented in Figure 2. For metacarpal* and phalangeal length measurements and for measurement of the distance of the four finger crotches above the wrist area, a horizontal baseline was drawn across the wrist region so that it passed through the most proximal point on the navicular tuberosity (point C in Figure 2). This line was established perpendicular to the long axis of the hand (line AB). For measurements across the hand to the midpoint of each of the four crotches, a vertical baseline was erected perpendicular to the horizontal baseline and passed through point E on the ulnar side of the hand. A separate baseline for measurement of digit I lengths was established perpendicular to the long axis of the thumb (line FG), passing through the tubercle of the greater multangular (point H).

Selection of these particular baselines satisfactorily met the stated conditions for the following reasons. First, measurements from the horizontal baseline yielded results comparable to those obtained by direct measurement. Hand length, measured directly, using the method described for the 1950 Survey (ref. 9), and X-ray hand length (as described in Figure 9), were obtained on a test sample of 10 volunteer subjects in order to compare, on each subject, the results of the two techniques. After correction for X-ray image enlargement, measured X-ray hand length differed from actual length on the order of only 1 percent. This difference was not statistically significant. Unfortunately, the vertical and the thumb baselines could not be submitted to the same kind of analysis because of the difficulties in measuring directly such dimensions as thumb length and breadths to the various crotches.

Second, variations in hand positioning on the X-ray film showed little effect on either length or breadth measurements. A portion of the sample test series was used to investigate the effects of differences in hand position. For each of the subjects X-rayed, two exposures were made of the right hand. In one exposure, the standard position with the arm, hand, and middle fingers in a straight line was assumed. In the second exposure, the hand was angled so that the straight line was no longer maintained. In no instance were

* See Figure 1 for an illustration of X-ray hand anatomy.

statistically significant differences noted in measurements as a result of these variations.

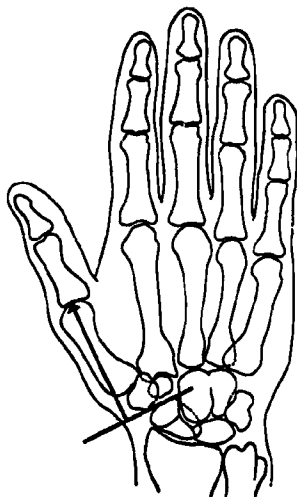
Third, inspection of the test X-rays indicated that the horizontal and thumb baselines showed little overall change in location due to variations in the two key landmarks, the navicular tuberosity and the tubercle of the greater multangular.

The final condition considered necessary in the establishment of workable baselines and landmarks was their reproducibility. Two independent observers, using written instructions describing the baselines and the measurements to be taken, were asked to measure a set of 20 X-rays. The differences between the two sets of observations were, in the large majority of cases, no greater than the measuring error of 1 millimeter.

The total list of dimensions measured in the present study includes the following:

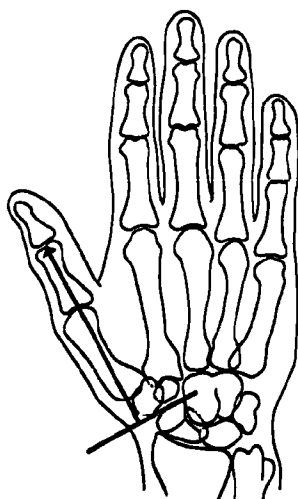
- a. height of each of the finger segments above the horizontal baseline,
- b. height of the four crotches,
- c. height of measured hand breadth on the ulnar side of the hand,
- d. breadth of each digit at the base and knuckle joints,
- e. hand breadth across the distal end of the metacarpals,
- f. breadth across the hand to the midpoint of each of the crotches,
- g. wrist breadth.

Detailed descriptions of each dimension are given in Figures 3 through 17. Each dimension has been given a number which appears in parentheses after its title. The numbering, designed primarily as an aid in the statistical reduction of the data, defines the order in which the measurements were made.



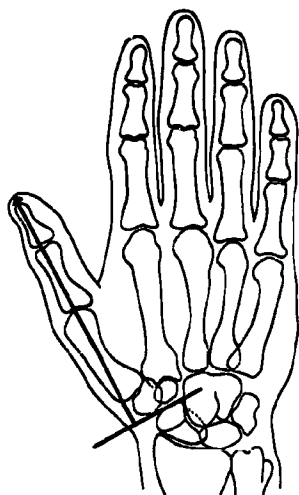
**Figure 3. Height of Metacarpal I
(no. 22)**

**Perpendicular distance from
thumb baseline to midpoint of
distal end of metacarpal I.**



**Figure 4. Height of Proximal
Phalanx I (no. 23)**

**Perpendicular distance from
thumb baseline to midpoint of
distal end of proximal phalanx I.**



**Figure 5. Height of Tip I
(no. 24)**

**Perpendicular distance from
thumb baseline to fleshy tip of
digit I.**

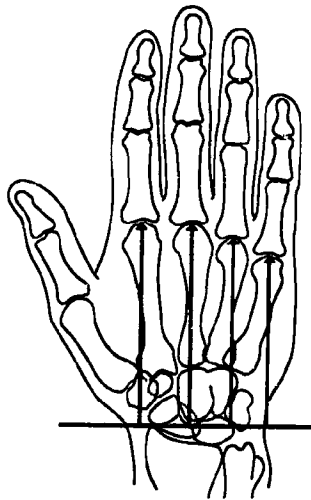


Figure 6. Heights of Metacarpals II-V (nos. 1, 6, 11, 16)

Perpendicular distance from horizontal baseline to midpoint of distal end of respective metacarpal.

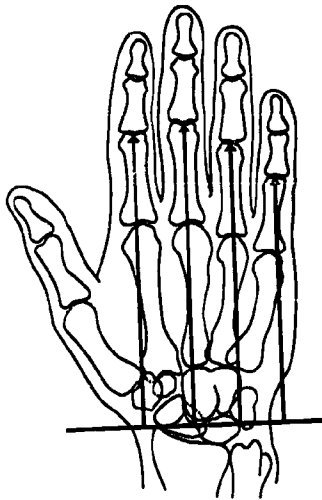


Figure 7. Heights of Proximal Phalanges II-V (nos. 2, 7, 12, 17)

Perpendicular distance from horizontal baseline to midpoint of distal end of respective proximal phalanx.

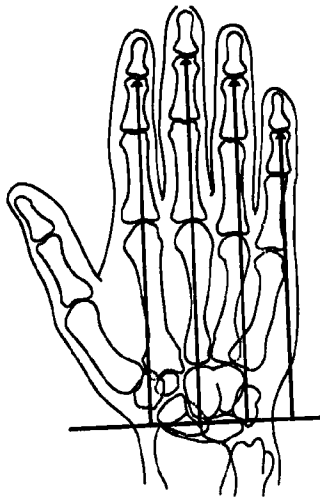
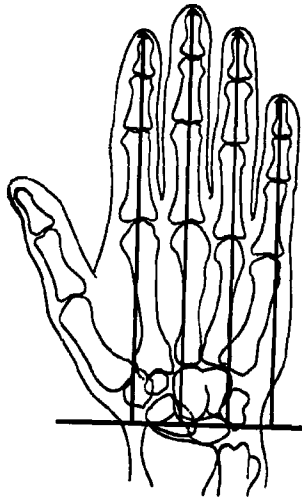


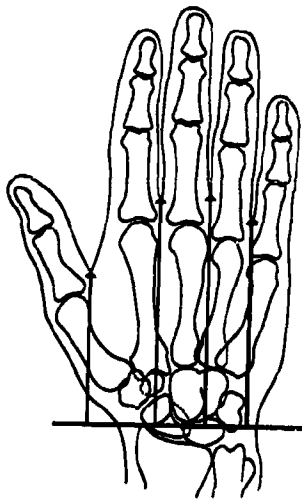
Figure 8. Heights of Middle Phalanges II-V (nos. 3, 8, 13, 18)

Perpendicular distance from horizontal baseline to midpoint of distal end of respective middle phalanx.



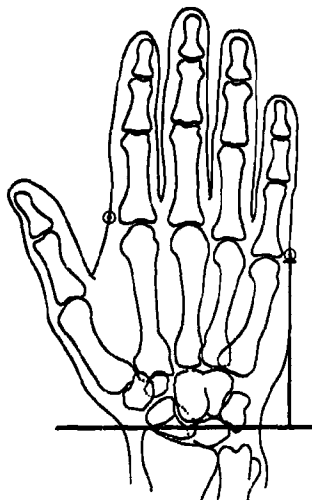
**Figure 9. Heights of Tips II-V
(nos. 4, 9, 14, 19)**

Perpendicular distance from horizontal baseline to midpoint of respective fleshy tip. Height of tip III is hand length.



**Figure 10. Heights of Crotches
I-IV (nos. 25, 5, 10, 15)**

Perpendicular distance from horizontal baseline to midpoint of respective crotch.



**Figure 11. Height of Measured
Hand Breadth (no. 21)**

Perpendicular distance from horizontal baseline to point E.

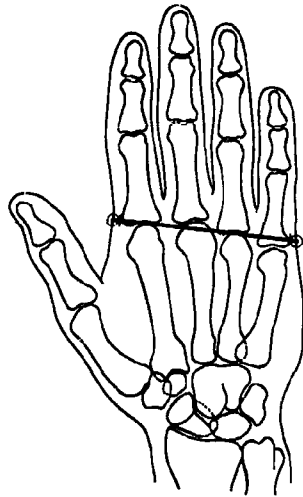


Figure 12. Hand Breadth (no. 27)

Distance between points D and E.

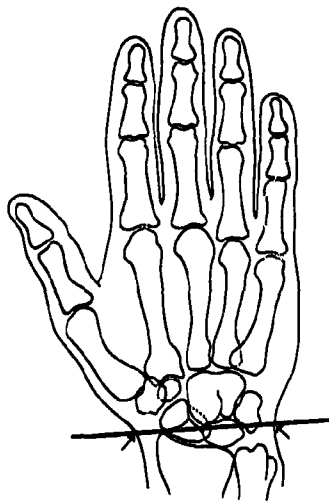


Figure 13. Wrist Breadth (no. 20)

Distance between fleshy margins in the wrist region measured along the horizontal baseline.

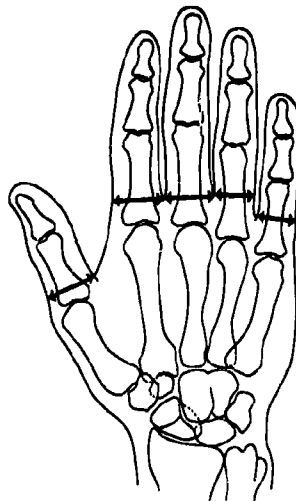


Figure 14. Breadths at Base of Digits I-V (nos. 28, 29, 32, 35, 38)

Breadth at crotch level measured perpendicular to long axis of the respective digit. Digit I is measured at level of crotch I, digits II and III at level of crotch II, digit IV at level of crotch III and digit V at level of crotch IV.

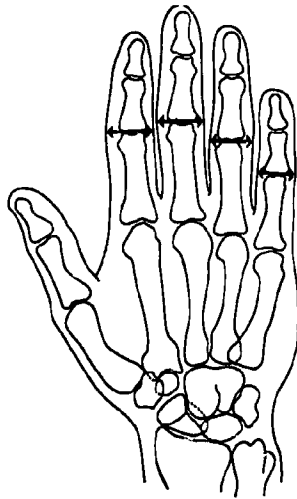


Figure 15. Breadths of Proximal Knuckles II-V (nos. 30, 33, 36, 39)

Distance across respective proximal knuckles, perpendicular to long axis of each digit.

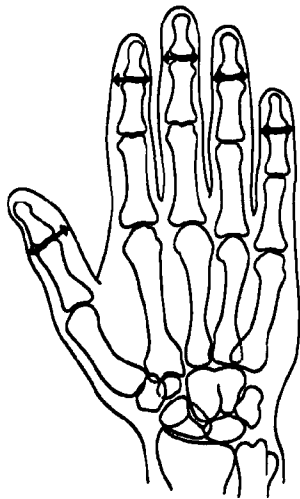


Figure 16. Breadths of Distal Knuckles II-V and Thickness of Interphalangeal Knuckle I (nos. 31, 34, 37, 40, 26)

Distance across respective distal knuckles, perpendicular to long axis of each digit.

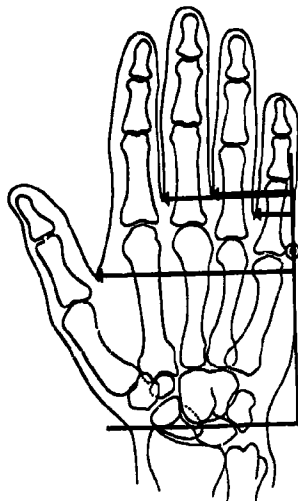


Figure 17. Vertical Baseline to Centers of Crotches I-IV (nos. 41-44)

Perpendicular distance from vertical baseline to midpoint of respective crotch.

SECTION III

SAMPLE SELECTION

The procedure for selection of a workable sample from the original set of 411 left-right hand X-rays involved a preliminary screening of all the films. To begin with, 88 films were rejected for technical reasons such as poor X-ray exposure and development, and other factors hindering accurate measurement. Further selection from the remaining 323 films was decided upon in an attempt to approximate closely the range and distribution of the hand length and hand breadth dimensions of the Air Force population as reported in Hertzberg et al. (ref. 9). This latter survey as measured in 1950 can be considered representative of the Air Force flying population.

The first step in fitting the X-ray series to the 1950 hand length - hand breadth distribution was to equate the two methods of measurement. As previously discussed, X-ray measurement of hand length differed from direct measurement by about 1 percent. A similar comparison of hand breadth was made on the test sample of 10 subjects. Results indicated that X-ray breadth measurements tended to exceed direct measurements by about 3 percent. This difference is perhaps attributable to the changes in finger position between the two techniques. In the direct method, the extended fingers were in contact (ref. 9), whereas in the X-ray technique (Figure 12) the fingers were separated far enough apart to avoid contact, resulting in a total breadth increase in the metacarpal-phalangeal region. It is also possible that compression of the flesh in the direct method and variations in hand pressure on the X-ray plate may have been a contributing factor to the 3 percent difference.

Taking these differences of 1 percent for length and 3 percent for breadth into account, the right hands of the remaining 323 subjects were measured for these two dimensions and adjusted accordingly after correction for X-ray magnification. (It must be emphasized that these corrections were employed only for the purposes of sample selection, and that in the final tabulation of results for all dimensions as they appear in this report, no further correction beyond adjustment for X-ray enlargement has been made.) Selection in terms of the 1950 Air Force survey data then proceeded in an attempted fit to the 1950 Hand Length-Hand Breadth Bivariate Table as found in Churchill et al. (ref. 4). The actual number of subjects needed to fill out one length and breadth interval on the Table was determined, and a fit to the general requirements of the total distribution, interval by interval, was approximated. Subjects who brought the quota for a particular interval beyond the actual requirement were excluded. The resulting sample arrived at by this method of selection consisted of 253 subjects. Table I presents a comparison of the means and standard deviations for the 1950 Survey population and the selected X-ray sample, once the latter had been adjusted to account for differences in measuring technique.

TABLE I

Comparison of Hand Lengths and Hand Breadths (in mm.) Between the
1950 Survey Sample and the Selected X-Ray Sample

	<u>1950 Survey Sample</u>	<u>X-Ray Sample*</u>
Sample Size	4063	253
Mean Length	190.23	190.46
S. D. Length	8.60	8.32
Mean Breadth	88.33	88.37
S. D. Breadth	4.11	3.71

* Length adjusted by 1%, breadth by 3% to account for differences in
measurement technique.

The differences between the two samples are so slight as to be insignificant. The conclusion can therefore be drawn that the selected X-ray sample of 253 conforms adequately to the hand length and hand breadth distribution of the Air Force flying population.

TABLE II
Percentile Distribution of Hand Lengths
Right Hand

	Percentiles in Millimeters										Percentiles in Inches									
	1	5	25	50	75	95	99	1	5	25	50	75	95	99	1	5	25	50	75	99
22. Ht. Metacarpal I	50.4	53.2	56.1	58.3	60.2	63.2	65.7	1.98	2.09	2.21	2.29	2.37	2.49	2.58						
23. Ht. Proximal Phalanx I	79.2	82.4	86.3	89.3	92.5	97.7	100.4	3.12	3.24	3.40	3.51	3.64	3.85	3.95						
24. Ht. Tip I	106.8	110.7	115.4	119.4	123.0	129.1	133.2	4.20	4.36	4.54	4.70	4.84	5.08	5.24						
1. Ht. Metacarpal II	81.0	83.7	87.6	90.8	93.5	98.4	101.9	3.19	3.29	3.45	3.57	3.68	3.88	4.01						
2. Ht. Proximal Phalanx II	117.4	122.3	127.5	131.7	135.8	142.7	146.7	4.62	4.82	5.02	5.18	5.35	5.62	5.77						
3. Ht. Middle Phalanx II	140.3	145.2	151.3	156.3	161.4	169.5	173.7	5.52	5.72	5.96	6.15	6.36	6.67	6.84						
4. Ht. Tip II	160.9	166.3	173.4	178.8	183.8	193.4	196.4	6.34	6.55	6.83	7.04	7.23	7.61	7.73						
6. Ht. Metacarpal III	82.4	85.1	89.6	92.5	95.5	99.4	102.1	3.24	3.35	3.53	3.64	3.76	3.91	4.02						
7. Ht. Proximal Phalanx III	124.0	128.6	134.1	138.0	142.7	149.1	152.3	4.88	5.06	5.28	5.43	5.62	5.87	5.99						
8. Ht. Middle Phalanx III	151.3	155.5	162.4	167.3	173.2	180.6	184.1	5.96	6.12	6.39	6.59	6.82	7.11	7.25						
9. Ht. Tip III - HAND LENGTH	173.2	178.2	186.5	191.9	197.0	205.9	210.3	6.82	7.01	7.34	7.56	7.76	8.11	8.28						
11. Ht. Metacarpal IV	75.3	77.8	82.2	85.3	88.6	92.5	95.0	2.96	3.06	3.24	3.36	3.49	3.64	3.74						
12. Ht. Proximal Phalanx IV	115.2	119.6	124.7	128.9	133.9	139.6	142.4	4.53	4.71	4.91	5.08	5.27	5.49	5.61						
13. Ht. Middle Phalanx IV	141.2	145.7	151.6	157.0	162.9	169.8	172.7	5.56	5.74	5.97	6.18	6.41	6.68	6.80						
14. Ht. Tip IV	163.9	168.8	175.7	181.1	187.0	195.6	200.3	6.45	6.65	6.92	7.13	7.36	7.70	7.89						
16. Ht. Metacarpal V	65.3	69.9	74.0	78.3	81.9	85.6	88.8	2.57	2.75	2.91	3.08	3.22	3.37	3.50						
17. Ht. Proximal Phalanx V	97.9	101.9	107.1	111.7	116.6	122.5	125.0	3.86	4.01	4.22	4.40	4.59	4.82	4.92						
18. Ht. Middle Phalanx V	115.4	119.8	126.3	131.9	137.3	143.7	148.1	4.54	4.72	4.97	5.19	5.41	5.66	5.83						
19. Ht. Tip V	135.3	140.5	147.3	153.1	159.5	166.8	169.5	5.33	5.53	5.80	6.03	6.28	6.57	6.67						
25. Ht. Crotch I	45.3	52.7	58.4	62.0	66.6	73.8	77.0	1.78	2.07	2.30	2.44	2.62	2.91	3.03						
5. Ht. Crotch II	95.7	99.6	103.8	107.1	109.9	115.8	118.6	3.77	3.92	4.09	4.22	4.33	4.56	4.67						
10. Ht. Crotch III	96.2	99.4	104.3	107.6	110.9	116.3	119.8	3.79	3.91	4.11	4.24	4.37	4.58	4.72						
15. Ht. Crotch IV	85.1	88.4	93.2	97.2	100.4	105.5	108.3	3.35	3.48	3.67	3.83	3.95	4.15	4.26						
21. Ht. Meas. Hand Breadth	65.9	70.1	74.6	79.2	82.9	87.6	90.8	2.60	2.76	2.94	3.12	3.26	3.45	3.57						

TABLE III
Percentile Distribution of Hand Breadths
Right Hand

	Percentiles in Millimeters										Percentiles in Inches									
	1	5	25	50	75	95	99	1	5	25	50	75	95	99	1	5	25	50	75	99
27. HAND BREADTH	80.9	83.9	87.9	90.6	93.0	97.6	98.9	3.19	3.30	3.46	3.57	3.66	3.84	3.89						
20. Wrist Breadth	62.0	64.0	67.1	69.4	71.9	77.1	78.9	2.44	2.52	2.64	2.73	2.83	3.03	3.11						
28. Breadth Base Digit I	20.0	21.1	22.8	24.0	25.4	27.2	28.9	0.79	0.83	0.90	0.95	1.00	1.07	1.14						
26. Thick. Interph. Knuckle I	19.7	20.5	21.7	22.4	23.3	24.7	25.7	0.78	0.81	0.85	0.88	0.92	0.97	1.01						
29. Breadth Base Digit II	19.3	20.5	21.7	22.6	23.4	24.8	25.3	0.76	0.81	0.85	0.89	0.92	0.98	1.00						
30. Breadth Proximal Knuckle II	19.1	19.7	20.6	21.4	22.2	23.1	23.7	0.75	0.78	0.81	0.84	0.88	0.91	0.93						
31. Breadth Distal Knuckle II	16.4	17.0	18.2	18.9	19.6	20.5	21.3	0.65	0.67	0.72	0.74	0.77	0.81	0.84						
32. Breadth Base Digit III	18.0	18.6	19.8	20.9	21.7	23.0	23.6	0.71	0.73	0.78	0.82	0.85	0.91	0.93						
33. Breadth Proximal Knuckle III	19.4	20.0	21.0	21.7	22.3	23.3	24.0	0.76	0.79	0.83	0.85	0.88	0.92	0.95						
34. Breadth Distal Knuckle III	15.9	16.6	17.8	18.5	19.3	20.2	21.1	0.63	0.65	0.70	0.73	0.76	0.79	0.83						
35. Breadth Base Digit IV	15.8	16.8	18.1	19.1	20.0	21.3	22.2	0.62	0.66	0.71	0.75	0.79	0.84	0.88						
36. Breadth Proximal Knuckle IV	17.7	18.7	19.5	20.1	20.7	21.8	22.6	0.70	0.74	0.77	0.79	0.81	0.86	0.89						
37. Breadth Distal Knuckle IV	15.3	16.0	16.9	17.5	18.2	19.3	20.0	0.60	0.63	0.67	0.69	0.72	0.76	0.79						
38. Breadth Base Digit V	15.5	16.3	17.4	18.3	19.2	20.3	21.5	0.61	0.64	0.69	0.72	0.76	0.80	0.84						
39. Breadth Proximal Knuckle V	15.7	16.1	17.0	17.5	18.3	19.5	20.4	0.62	0.64	0.67	0.69	0.72	0.77	0.80						
40. Breadth Distal Knuckle V	14.0	14.9	15.8	16.4	17.2	18.2	18.9	0.55	0.59	0.62	0.65	0.68	0.72	0.74						
41. Vert. Baseline to Crotch I	86.3	91.0	95.0	97.9	101.4	105.8	109.3	3.40	3.58	3.74	3.86	3.99	4.17	4.30						
42. Vert. Baseline to Crotch II	56.8	60.0	62.7	64.8	67.1	70.1	71.6	2.24	2.36	2.47	2.55	2.64	2.76	2.82						
43. Vert. Baseline to Crotch III	34.8	37.7	40.0	41.5	42.6	44.3	45.9	1.37	1.48	1.57	1.64	1.68	1.74	1.81						
44. Vert. Baseline to Crotch IV	16.2	17.3	19.0	20.2	21.2	22.5	23.7	0.64	0.68	0.75	0.79	0.83	0.89	0.93						

TABLE IV
Percentile Distribution of Hand Lengths
Left Hand

	Percentiles in Millimeters										Percentiles in Inches									
	1	5	25	50	75	95	99	1	5	25	50	75	95	99						
22. Ht. Metacarpal I	49.7	52.0	54.8	57.4	59.8	62.3	63.7	1.96	2.05	2.16	2.26	2.36	2.45	2.51						
23. Ht. Proximal Phalanx I	79.2	81.7	85.6	88.6	92.2	96.5	98.6	3.12	3.22	3.37	3.49	3.63	3.80	3.88						
24. Ht. Tip I	106.3	109.0	114.4	118.1	122.1	127.0	130.4	4.19	4.29	4.50	4.65	4.81	5.00	5.13						
1. Ht. Metacarpal II	81.7	83.7	88.1	91.2	93.5	97.9	101.7	3.22	3.29	3.47	3.59	3.68	3.68	4.00						
2. Ht. Proximal Phalanx II	118.9	121.8	127.7	132.1	136.0	142.5	146.5	4.68	4.79	5.03	5.20	5.36	5.61	5.77						
3. Ht. Middle Phalanx II	141.0	144.5	151.6	156.8	161.4	168.3	174.7	5.55	5.69	5.97	6.17	6.36	6.63	6.88						
4. Ht. Tip II	161.4	165.9	172.9	179.1	183.8	191.6	197.8	6.36	6.53	6.81	7.05	7.23	7.54	7.79						
6. Ht. Metacarpal III	82.7	85.1	89.3	92.5	95.0	99.2	100.7	3.26	3.35	3.51	3.64	3.74	3.91	3.96						
7. Ht. Proximal Phalanx III	125.5	128.4	133.6	138.3	142.4	148.6	151.1	4.94	5.06	5.26	5.44	5.61	5.85	5.95						
8. Ht. Middle Phalanx III	151.1	155.5	162.4	167.5	172.7	179.6	182.6	5.95	6.12	6.39	6.60	6.80	7.07	7.19						
9. Ht. Tip III - HAND LENGTH	173.5	178.2	186.0	191.4	197.2	204.7	208.6	6.83	7.01	7.32	7.54	7.76	8.06	8.21						
11. Ht. Metacarpal IV	76.6	78.7	82.4	85.3	87.8	91.7	94.0	3.01	3.10	3.24	3.36	3.46	3.61	3.70						
12. Ht. Proximal Phalanx IV	115.4	119.3	123.7	128.2	132.9	138.8	141.4	4.54	4.70	4.87	5.05	5.23	5.46	5.57						
13. Ht. Middle Phalanx IV	141.5	145.2	150.8	156.5	161.9	169.0	172.0	5.57	5.72	5.94	6.16	6.37	6.65	6.77						
14. Ht. Tip IV	163.9	168.6	174.7	180.6	187.0	194.7	197.8	6.45	6.64	6.88	7.11	7.36	7.66	7.79						
16. Ht. Metacarpal V	67.4	70.2	73.5	76.8	81.2	86.1	87.8	2.65	2.76	2.89	3.02	3.20	3.39	3.46						
17. Ht. Proximal Phalanx V	98.4	101.4	105.8	110.5	115.5	121.6	123.7	3.88	3.99	4.17	4.35	4.55	4.79	4.87						
18. Ht. Middle Phalanx V	116.6	120.1	125.5	130.9	136.3	143.9	147.2	4.59	4.73	4.94	5.15	5.37	5.67	5.79						
19. Ht. Tip V	136.1	140.3	146.2	152.6	158.5	166.6	169.8	5.36	5.52	5.75	6.01	6.24	6.56	6.68						
25. Ht. Crotch I	47.2	52.2	58.1	61.3	65.9	72.8	76.3	1.86	2.05	2.29	2.41	2.60	2.87	3.00						
5. Ht. Crotch II	95.2	99.4	103.2	107.0	109.7	115.0	117.9	3.75	3.91	4.06	4.21	4.32	4.53	4.64						
10. Ht. Crotch III	96.7	99.1	103.3	107.6	110.2	115.9	118.1	3.81	3.90	4.07	4.24	4.34	4.56	4.65						
15. Ht. Crotch IV	85.3	88.3	92.7	96.2	99.4	104.3	107.3	3.36	3.48	3.65	3.79	3.91	4.11	4.22						
21. Ht. Meas. Hand Breadth	67.4	69.9	74.3	77.8	82.0	86.3	89.1	2.65	2.75	2.93	3.06	3.23	3.40	3.51						

TABLE V
Percentile Distribution of Hand Breadths
Left Hand

	Percentiles in Millimeters										Percentiles in Inches									
	1	5	25	50	75	95	99	1	5	25	50	75	95	99						
27. HAND BREADTH	80.7	82.9	86.8	89.1	92.0	96.5	99.1	3.18	3.26	3.42	3.51	3.62	3.80	3.90						
20. Wrist Breadth	61.5	63.5	66.6	68.9	71.6	77.5	80.4	2.42	2.50	2.62	2.71	2.82	3.05	3.17						
28. Breadth Base Digit I	19.6	20.7	22.2	23.0	24.2	26.0	27.1	0.77	0.81	0.88	0.90	0.95	1.02	1.07						
26. Thick. Interph. Knuckle I	19.5	20.3	21.6	22.3	23.1	24.2	25.1	0.77	0.80	0.85	0.88	0.91	0.95	0.99						
29. Breadth Base Digit II	19.6	20.2	21.5	22.3	23.3	25.0	25.9	0.77	0.79	0.84	0.88	0.92	0.98	1.02						
30. Breadth Proximal Knuckle II	19.0	19.7	20.6	21.2	21.9	22.8	23.4	0.75	0.78	0.81	0.83	0.86	0.90	0.92						
31. Breadth Distal Knuckle II	16.5	17.0	17.8	18.4	19.0	20.1	21.0	0.65	0.67	0.70	0.72	0.75	0.79	0.83						
32. Breadth Base Digit III	17.4	18.4	19.8	20.7	21.6	23.0	24.0	0.69	0.72	0.78	0.81	0.85	0.91	0.95						
33. Breadth Proximal Knuckle III	18.3	19.2	20.3	21.1	21.9	22.9	23.7	0.72	0.76	0.80	0.83	0.86	0.90	0.93						
34. Breadth Distal Knuckle III	15.0	15.8	17.1	18.0	18.8	19.9	20.8	0.59	0.62	0.67	0.71	0.74	0.78	0.82						
35. Breadth Base Digit IV	15.4	16.1	17.6	18.5	19.3	20.7	21.5	0.60	0.64	0.69	0.73	0.76	0.81	0.84						
36. Breadth Proximal Knuckle IV	17.6	18.2	19.0	19.7	20.5	21.6	22.2	0.69	0.72	0.75	0.78	0.81	0.85	0.88						
37. Breadth Distal Knuckle IV	14.9	15.5	16.4	17.1	17.9	19.0	19.9	0.59	0.61	0.65	0.67	0.71	0.75	0.78						
38. Breadth Base Digit V	14.8	15.6	16.7	17.5	18.5	19.9	20.8	0.58	0.61	0.66	0.69	0.73	0.78	0.82						
39. Breadth Proximal Knuckle V	15.3	15.9	16.6	17.2	17.9	19.1	20.1	0.60	0.63	0.65	0.68	0.71	0.75	0.79						
40. Breadth Distal Knuckle V	14.1	14.7	15.6	16.2	16.8	17.7	18.4	0.55	0.58	0.61	0.64	0.66	0.70	0.72						
41. Vert. Baseline to Crotch I	86.1	89.8	93.7	97.2	101.6	106.3	109.9	3.39	3.53	3.69	3.83	4.00	4.19	4.33						
42. Vert. Baseline to Crotch II	55.8	57.8	60.8	63.2	65.6	69.1	71.5	2.20	2.27	2.39	2.49	2.58	2.72	2.81						
43. Vert. Baseline to Crotch III	34.5	36.1	38.2	39.8	41.7	44.3	46.1	1.36	1.42	1.50	1.57	1.64	1.74	1.81						
44. Vert. Baseline to Crotch IV	14.6	15.9	17.8	18.9	20.0	21.9	23.6	0.57	0.63	0.70	0.74	0.79	0.86	0.93						

TABLE VI
Statistical Summary of Hand Lengths
Right Hand

	Mean mm.	S. E. mm.	Mean in.	S. E. in.	Standard Deviation mm.	Standard Deviation in.	C. V. %
22. Ht. Metacarpal I	58.68	0.20	2.31	0.008	3.18	0.12	5.42
23. Ht. Proximal Phalanx I	90.05	0.29	3.54	0.011	4.68	0.18	5.20
24. Ht. Tip I	119.84	0.35	4.72	0.014	5.62	0.22	4.69
1. Ht. Metacarpal II	91.26	0.28	3.59	0.011	4.48	0.18	4.91
2. Ht. Proximal Phalanx II	122.35	0.39	5.21	0.015	6.15	0.24	4.65
3. Ht. Middle Phalanx II	157.04	0.46	6.18	0.018	7.26	0.28	4.62
4. Ht. Tip II	179.41	0.50	7.06	0.020	7.93	0.31	4.42
6. Ht. Metacarpal III	92.92	0.27	3.66	0.011	4.33	0.17	4.66
7. Ht. Proximal Phalanx III	138.87	0.39	5.47	0.015	6.25	0.25	4.50
8. Ht. Middle Phalanx III	168.39	0.47	6.63	0.018	7.51	0.30	4.46
9. Ht. Tip III - HAND LENGTH	192.47	0.52	7.58	0.020	8.23	0.32	4.28
11. Ht. Metacarpal IV	86.53	0.28	3.41	0.011	4.45	0.18	5.14
12. Ht. Proximal Phalanx IV	129.68	0.39	5.10	0.015	6.20	0.24	4.78
13. Ht. Middle Phalanx IV	157.79	0.46	6.21	0.018	7.39	0.29	4.68
14. Ht. Tip IV	181.93	0.51	7.16	0.020	8.14	0.32	4.47
16. Ht. Metacarpal V	78.43	0.32	3.09	0.012	5.06	0.20	6.45
17. Ht. Proximal Phalanx V	112.42	0.40	4.42	0.016	6.38	0.25	5.68
18. Ht. Middle Phalanx V	132.44	0.46	5.21	0.018	7.37	0.29	5.56
19. Ht. Tip V	153.87	0.50	6.06	0.020	8.03	0.32	5.22
25. Ht. Crotch I	63.05	0.41	2.48	0.016	6.46	0.25	10.24
5. Ht. Crotch II	107.55	0.30	4.23	0.012	4.74	0.19	4.41
10. Ht. Crotch III	108.14	0.31	4.27	0.012	4.97	0.20	4.60
15. Ht. Crotch IV	97.36	0.32	3.83	0.012	5.07	0.20	5.21
21. Ht. Meas. Hand Breadth	79.44	0.34	3.13	0.013	5.48	0.22	6.90

TABLE VII
Statistical Summary of Hand Breadths
Right Hand

	Mean mm.	S. E. mm.	Mean in.	S. E. in.	Standard Deviation mm.	Standard Deviation in.	C. V. %
27. HAND BREADTH							
20. Wrist Breadth	91.01 70.25	0.24 0.24	3.58 2.76	0.009 0.009	3.91 3.82	0.15 0.15	4.30 5.44
28. Breadth Base Digit I	24.63	0.12	0.97	0.005	1.86	0.07	7.55
26. Thick. Interph. Knuckle I	23.03	0.07	0.91	0.003	1.17	0.05	5.08
29. Breadth Base Digit II	23.03	0.08	0.91	0.003	1.35	0.05	5.86
30. Breadth Proximal Knuckle II	22.06	0.06	0.87	0.002	1.00	0.04	4.53
31. Breadth Distal Knuckle II	19.30	0.06	0.76	0.002	0.98	0.04	5.08
32. Breadth Base Digit III	21.30	0.08	0.84	0.003	1.35	0.05	6.34
33. Breadth Proximal Knuckle III	22.14	0.07	0.87	0.002	1.06	0.04	4.79
34. Breadth Distal Knuckle III	19.03	0.06	0.75	0.002	1.01	0.04	5.31
35. Breadth Base Digit IV	19.50	0.09	0.77	0.004	1.43	0.06	7.33
36. Breadth Proximal Knuckle IV	20.59	0.06	0.81	0.002	0.94	0.04	4.56
37. Breadth Distal Knuckle IV	17.95	0.06	0.71	0.002	0.94	0.04	5.24
38. Breadth Base Digit V	18.80	0.08	0.74	0.003	1.28	0.05	6.81
39. Breadth Proximal Knuckle V	18.16	0.06	0.71	0.002	1.01	0.04	5.56
40. Breadth Distal Knuckle V	16.86	0.06	0.66	0.002	0.95	0.04	5.63
41. Vert. Baseline to Crotch I	98.60	0.29	3.88	0.011	4.68	0.18	4.75
42. Vert. Baseline to Crotch II	65.40	0.20	2.58	0.008	3.23	0.13	4.94
43. Vert. Baseline to Crotch III	42.06	0.15	1.66	0.006	2.40	0.09	5.71
44. Vert. Baseline to Crotch IV	20.58	0.10	0.81	0.004	1.59	0.06	7.72

TABLE VIII
Statistical Summary of Hand Lengths
Left Hand

	Mean mm.	S. E. mm.	Mean in.	S. E. in.	Standard Deviation mm.	Standard Deviation in.	C. V. %
22. Ht. Metacarpal I	57.76	0.20	2.27	0.008	3.23	0.13	5.59
23. Ht. Proximal Phalanx I	89.42	0.29	3.52	0.011	4.59	0.18	5.13
24. Ht. Tip I	118.60	0.35	4.67	0.014	5.53	0.22	4.66
1. Ht. Metacarpal II	91.48	0.27	3.60	0.011	4.31	0.17	4.71
2. Ht. Proximal Phalanx II	132.50	0.38	5.22	0.015	6.08	0.24	4.59
3. Ht. Middle Phalanx II	157.05	0.45	6.18	0.018	7.16	0.28	4.56
4. Ht. Tip II	179.27	0.49	7.06	0.019	7.85	0.31	4.38
6. Ht. Metacarpal III	92.76	0.26	3.65	0.010	4.13	0.16	4.45
7. Ht. Proximal Phalanx III	138.58	0.38	5.46	0.015	6.01	0.24	4.34
8. Ht. Middle Phalanx III	168.06	0.46	6.62	0.018	7.24	0.28	4.31
9. Ht. Tip III - HAND LENGTH	191.94	0.50	7.56	0.020	8.03	0.32	4.18
11. Ht. Metacarpal IV	86.00	0.27	3.38	0.011	4.28	0.17	4.98
12. Ht. Proximal Phalanx IV	128.92	0.38	5.08	0.015	6.02	0.24	4.67
13. Ht. Middle Phalanx IV	157.06	0.46	6.18	0.018	7.27	0.29	4.63
14. Ht. Tip IV	181.37	0.50	7.14	0.020	8.04	0.32	4.43
16. Ht. Metacarpal V	77.80	0.30	3.06	0.012	4.81	0.19	6.18
17. Ht. Proximal Phalanx V	111.52	0.39	4.39	0.015	6.22	0.24	5.58
18. Ht. Middle Phalanx V	131.71	0.46	5.18	0.018	7.29	0.29	5.53
19. Ht. Tip V	153.12	0.50	6.03	0.019	7.90	0.31	5.16
25. Ht. Crotch I	62.50	0.38	2.46	0.015	6.04	0.24	9.66
5. Ht. Crotch II	107.25	0.29	4.22	0.011	4.68	0.18	4.36
10. Ht. Crotch III	107.76	0.31	4.24	0.012	4.92	0.19	4.56
15. Ht. Crotch IV	96.70	0.31	3.81	0.012	4.90	0.19	5.07
21. Ht. Meas. Hand Breadth	78.63	0.32	3.10	0.012	5.13	0.20	6.52

TABLE IX
Statistical Summary of Hand Breadths
Left Hand

	Mean mm.	S. E. mm.	Mean in.	S. E. in.	Standard Deviation mm.	Standard Deviation in.	C. V. %
27. HAND BREADTH							
20. Wrist Breadth	89.94 69.96	0.25 0.26	3.54 2.75	0.010 0.010	3.99 4.14	0.16 0.16	4.44 5.92
28. Breadth Base Digit I	23.75	0.10	0.94	0.004	1.57	0.06	6.61
26. Thick. Interph. Knuckle I	22.75	0.07	0.90	0.003	1.17	0.05	5.14
29. Breadth Base Digit II	22.93	0.09	0.90	0.004	1.45	0.06	6.32
30. Breadth Proximal Knuckle II	21.69	0.06	0.85	0.002	1.02	0.04	4.70
31. Breadth Distal Knuckle II	18.76	0.07	0.74	0.002	1.06	0.04	5.65
32. Breadth Base Digit III	21.17	0.09	0.83	0.003	1.39	0.05	6.56
33. Breadth Proximal Knuckle III	21.58	0.07	0.85	0.002	1.11	0.04	5.14
34. Breadth Distal Knuckle III	18.51	0.06	0.73	0.002	1.03	0.04	5.56
35. Breadth Base Digit IV	18.98	0.08	0.75	0.003	1.34	0.05	7.06
36. Breadth Proximal Knuckle IV	20.26	0.06	0.80	0.002	1.01	0.04	4.98
37. Breadth Distal Knuckle IV	17.62	0.06	0.69	0.002	0.98	0.04	5.56
38. Breadth Base Digit V	18.15	0.08	0.71	0.003	1.34	0.05	7.38
39. Breadth Proximal Knuckle V	17.84	0.06	0.70	0.002	1.04	0.04	5.83
40. Breadth Distal Knuckle V	16.67	0.06	0.66	0.002	0.94	0.04	5.64
41. Vert. Baseline to Crotch I	98.09	0.33	3.86	0.013	5.30	0.21	5.40
42. Vert. Baseline to Crotch II	63.80	0.22	2.51	0.009	3.45	0.14	5.41
43. Vert. Baseline to Crotch III	40.55	0.16	1.60	0.006	2.52	0.10	6.21
44. Vert. Baseline to Crotch IV	19.44	0.11	0.76	0.004	1.79	0.07	9.21

SECTION IV

RESULTS AND DISCUSSION

The major results of this study are presented in several sets of Tables. Percentile distributions are given in Tables II-V. Other basic summary statistics for each of the 44 dimensions appear in Tables VI-IX. Correlation coefficient matrices are in Appendix II, with mean correlation values listed in Table X. Differences between right and left hand values appear in Tables XI and XII and right-left hand correlations in Table XIII. These Tables and the material in them are discussed in this Section.

Summary Statistics

Behind the application of many standard statistical procedures to biological data is the assumption that the data are normally distributed. In a normal distribution, the 50th percentile (also called the median, the middle value in any distribution when the data are ranked according to size) and the mean coincide. In the present data as listed in percentile form in Tables II-V, slight differences between the mean values and their corresponding medians can be noted. These differences, however, have not been considered large enough to affect the shape of the distributions. Thus, the data herein have been treated as though the distributions were normal, and standard statistical techniques have been employed in all phases of data reduction.

The summary statistics presented in Tables VI-IX include the following:

- | | |
|--------------------------------------|---|
| a. mean (\bar{x}) | the sum of all the items divided by the sample size (N) |
| b. standard deviation (S.D.) | the standard measure of variability computed by taking the square root of the mean of the squared deviations from the mean |
| c. standard error of the mean (S.E.) | an estimate of how far from the true population mean the sample mean falls, computed by dividing the S.D. by the square root of N |
| d. coefficient of variation (C.V.) | the standard deviation expressed as a percent of the mean |

Since the coefficient of variation (C.V.) is the standard deviation expressed as a percentage of its mean, it follows that the greater the C.V., the greater the relative variability in the data. In Tables VI through IX, the largest C.V.'s for both hands are to be noted for the height of crotch I and distance from the vertical baseline to the midpoint of crotch IV. As mentioned previously, control over thumb positioning was not rigidly maintained. The fleshy portion between the thumb and the index finger as recorded on the X-ray films was therefore highly susceptible to differences in positioning. A similar explanation probably accounts for the larger C.V.'s for both hands for the

dimension vertical baseline to crotch IV. Thus, the greater variability of these dimensions is probably not due to inherent peculiarities of the data, but to external factors.

In connection with the work of those persons concerned with relative finger lengths as a sex and racial characteristic, it is interesting to note that for both the left and the right hands, the average distance from the horizontal baseline to the fleshy tip of the fourth digit exceeds a comparable measurement of the second digit. For the right hand, 68 percent of the 253 subjects evidenced this pattern. These findings are in agreement with those of George (ref. 8) and Phelps (ref. 11) who found that in over 50 percent of their respective samples, this pattern prevailed. (For the female samples a reverse situation had been characteristic.) Direct comparison of values between the present data and those of George and Phelps is not possible, however, owing to the differences in measuring technique. George had used a calibrated finger board designed to measure the distance from the fleshy crotch to the tip of each digit and Phelps had relied upon outline tracings of the hand.

Coefficients of Correlation

Means, standard deviations and percentiles are useful tools in the descriptive summarization of a body of data on an item by item basis. Of further use is the coefficient of correlation which describes the degree of interrelationship between items. To what extent is hand length associated with hand breadth, for example? Are these two dimensions so closely inter-related that the size of one can be reasonably predicted from the size of the other? The high degree of interrelationship between certain body dimensions has provided the basis upon which some garment-sizing programs have been successfully designed and put into operation [see Emanuel et al. (ref. 6), and Barter and Alexander (ref. 1)].

The coefficient of correlation (r) describes the degree or intensity of the relationship (the extent to which they vary together) between two variables. The closer the coefficient of correlation approaches ± 1.00 or unity, the greater the relationship and the more possible it becomes to predict accurately one variable from another. Conversely, as the correlation approaches zero, the relationship decreases and the success of estimating one variable from another becomes negligible. In rough outline, it can be said that correlations ranging from 0.00 to ± 0.39 are low, from ± 0.40 to $\pm .79$ moderate, and from ± 0.80 to ± 1.00 high. For a discussion of the method for computing the coefficient of correlation, see Fisher (ref. 7).

The complete correlation matrices for the right and left hands are to be found in Appendix II. In evaluating the values given in these matrices, it is important to recall that small values are not only indicative of, at most, rather low degrees of relationship, but may also be merely the result of chance variation. Values of r based on samples of the present size ($N = 253$) are significantly greater than zero (at the 1 percent level of confidence) if they exceed ± 0.165 in magnitude (ref. 14).

In order to facilitate summarization of the intercorrelation matrices, mean r 's were computed for each of the 44 hand dimensions. A mean r for a particular dimension thus represents the average of all r values resulting from the correlation between that dimension and the remaining 43. The method of

TABLE X
Mean Coefficients of Correlation Per Dimension
Both Hands

Dimension	Mean r		Rank		Dimension	Mean r		Rank	
	Right	Left	Right	Left		Right	Left	Right	Left
Ht. Middle Phalanx IV	.719	.717	1	1	Vert. Baseline to Crotch II	.536	.504	23	24
Ht. Proximal Phalanx IV	.719	.709	2	4	HAND BREADTH	.529	.532	24	22
Ht. Tip IV	.717	.712	3	3	Vert. Baseline to Crotch III	.490	.492	25	25
Ht. Middle Phalanx III	.714	.712	4	2	Breadth Proximal Knuckle III	.475	.445	26	29
Ht. Proximal Phalanx III	.712	.700	5	6	Ht. Metacarpal I	.459	.462	27	27
Ht. Tip III - HAND LENGTH	.706	.703	6	5	Breadth Distal Knuckle III	.435	.463	28	26
Ht. Metacarpal IV	.675	.658	7	10	Breadth Proximal Knuckle II	.433	.435	29	32
Ht. Middle Phalanx V	.669	.664	8	8	Vert. Baseline to Crotch I	.432	.423	30	34
Ht. Metacarpal III	.666	.664	9	9	Breadth Distal Knuckle II	.413	.447	31	28
Ht. Proximal Phalanx V	.665	.655	10	11	Wrist Breadth	.411	.420	32	35
Ht. Tip II	.658	.639	11	13	Thickness Interphalangeal Knuckle I	.408	.439	33	30
Ht. Middle Phalanx II	.654	.646	12	12	Breadth Distal Knuckle IV	.403	.437	34	31
Ht. Crotch III	.652	.631	13	14	Vert. Baseline to Crotch IV	.390	.353	35	39
Ht. Tip V	.635	.666	14	7	Breadth Proximal Knuckle IV	.387	.414	36	37
Ht. Crotch IV	.628	.622	15	16	Breadth Base Digit III	.386	.335	37	42
Ht. Crotch II	.616	.598	16	17	Breadth Base Digit II	.380	.389	38	38
Ht. Metacarpal V	.603	.590	17	18	Breadth Distal Knuckle V	.377	.417	39	36
Ht. Proximal Phalanx II	.600	.624	18	15	Breadth Proximal Knuckle V	.351	.435	40	33
Ht. Tip I	.584	.577	19	19	Breadth Base Digit IV	.339	.325	41	43
Ht. Meas. Hand Breadth	.581	.555	20	20	Breadth Base Digit V	.329	.351	42	40
Ht. Metacarpal I	.561	.540	21	21	Breadth Base Digit I	.281	.345	43	41
Ht. Proximal Phalanx I	.557	.526	22	23	Ht. Crotch I	.228	.227	44	44

computation involved the transformation of all \bar{r} values to Fisher's z 's (ref. 7), the calculation of the mean \bar{z} per dimension, and the conversion of the mean \bar{z} back to \bar{r} . Table X contains 44 mean \bar{r} values ordered on the basis of magnitude of the values for the right hand. Mean \bar{r} 's and rankings for the left hand have also been included for comparative purposes.

As Table X demonstrates, the highest mean \bar{r} 's occur for the length dimensions. In fact, for the right hand, only two lengths, the height of metacarpal I and height of crotch I, do not fall in the upper half of the ranking with the other lengths. An identical pattern exists for the left hand with the exception of one length dimension, the height of proximal phalanx I, which also falls below the upper half of the listing. Explanation for the location of height of crotch I at the bottom of the entire ranking probably lies in the previously mentioned fact that positioning of the thumb was not closely controlled, resulting in greater variability in the crotch I area.

On the whole, it would seem that the lengths show far greater inter-relationship with both length and breadth dimensions than do the breadths. On a more specific basis, reference to the complete intercorrelation matrices provides further discussion. The highest r values are to be found in the relationships between the total length of a digit and the various segments of the same digit. For example,

Ht. of Tip I with Ht. of Proximal Phalanx I	.958 (.952)*
Ht. of Tip II with Ht. of Middle Phalanx II	.980 (.979)
Ht. of Tip III with Ht. of Middle Phalanx III	.979 (.982)
Ht. of Tip IV with Ht. of Middle Phalanx IV	.982 (.983)
Ht. of Tip V with Ht. of Middle Phalanx V	.958 (.983)

High correlations are also to be found between the heights of the fleshy tips of each digit. For example, hand length (total height of the third digit above the horizontal baseline) correlates with each of the other total digit lengths as follows:

Ht. Tip I	.805 (.792)
Ht. Tip II	.930 (.925)
Ht. Tip IV	.944 (.946)
Ht. Tip V	.824 (.831)

In general, all correlations involving breadths with breadths show relatively lower \bar{r} 's than those among the length dimensions. For example, hand breadth correlates with other breadth dimensions as follows:

Wrist Breadth	.616 (.603)
Vertical Baseline to Crotch I	.760 (.690)
Vertical Baseline to Crotch II	.910 (.899)
Vertical Baseline to Crotch III	.768 (.798)
Vertical Baseline to Crotch IV	.506 (.525)
Breadth at Base of Digit III	.599 (.543)
Breadth of Proximal Knuckle III	.712 (.640)
Breadth of Distal Knuckle III	.583 (.603)

* \bar{r} for left hand in parentheses throughout.

TABLE XI
Right Hand Minus Left Hand Comparisons (in mm.)
Lengths

	\bar{x} Right	\bar{x} Left	\bar{x} Diff.	S. D. Diff.	S. E. Diff.	t *
22. Ht. Metacarpal I	58.68	57.76	0.92	1.98	.124	7.42
23. Ht. Proximal Phalanx I	90.05	89.42	0.63	2.25	.141	4.47
24. Ht. Tip I	119.84	118.60	1.24	2.34	.147	8.44
1. Ht. Metacarpal II	91.26	91.48	-0.22	2.09	.131	1.68
2. Ht. Proximal Phalanx II	132.35	132.50	-0.15	2.29	.144	1.04
3. Ht. Middle Phalanx II	157.04	157.05	-0.01	2.27	.143	0.07
4. Ht. Tip II	179.41	179.27	0.14	2.37	.149	0.94
6. Ht. Metacarpal III	92.92	92.76	0.16	1.56	.098	1.63
7. Ht. Proximal Phalanx III	138.87	138.58	0.29	1.85	.116	2.50
8. Ht. Middle Phalanx III	168.39	168.06	0.33	2.01	.126	2.62
9. Ht. Tip III - HAND LENGTH	192.47	191.94	0.53	2.22	.140	3.78
11. Ht. Metacarpal IV	86.53	86.00	0.53	2.33	.146	3.63
12. Ht. Proximal Phalanx IV	129.68	128.92	0.76	2.56	.161	4.72
13. Ht. Middle Phalanx IV	157.79	157.06	0.73	2.59	.163	4.48
14. Ht. Tip IV	181.93	181.37	0.56	2.70	.170	3.29
16. Ht. Metacarpal V	78.43	77.80	0.63	3.40	.214	2.94
17. Ht. Proximal Phalanx V	112.42	111.52	0.90	3.71	.233	3.86
18. Ht. Middle Phalanx V	132.44	131.71	0.73	3.85	.242	3.02
19. Ht. Tip V	153.87	153.12	0.75	4.02	.253	2.96
25. Ht. Crotch I	63.05	62.50	0.55	4.35	.273	2.01
5. Ht. Crotch II	107.55	107.25	0.30	2.06	.130	2.31
10. Ht. Crotch III	108.14	107.76	0.38	2.23	.140	2.71
15. Ht. Crotch IV	97.36	96.70	0.66	3.13	.197	3.35
21. Ht. Meas. Hand Breadth	79.44	78.63	0.81	3.76	.236	3.43

* For an N of 253, any t value greater than 2.59 is statistically significant at the 1% level of confidence.

On the whole, low order r 's occur in the correlations between breadths and lengths. For example, wrist breadth correlates with each of the components of digit III as follows:

Ht. of Metacarpal III	.336 (.354)
Ht. of Proximal Phalanx III	.355 (.394)
Ht. of Middle Phalanx III	.364 (.397)
Ht. of Tip III	.363 (.404)

Most of the r values that are smaller than ± 0.165 , or, in other words, not statistically significant, involve correlations between knuckle breadths and height of the various crotches, particularly crotch I.

Hand breadth and vertical baseline to crotches II and III are the only breadth dimensions which evidence moderate correlations with any of the lengths, generally on the order of 0.5. For example, the correlation coefficient between hand breadth and hand length is 0.559 (0.575). These correlations fall roughly midway between a correlation of 0.671 found by Barter and Alexander in their survey of 100 Air Force males (ref. 1) and 0.525 calculated for the survey of more than 4000 Air Force men (ref. 9). The differences in the magnitude of the coefficients of correlation among the present data and the other survey data could possibly be a function of differences in sample size.

Comparison Between The Left and Right Hands

In a comparison of left and right hand size, it is notable that in the majority of cases, the right hand exceeds the left in both length and breadth dimensions. As Tables XI and XII demonstrate, the mean differences are generally less than 1 millimeter, the exceptions being the height of the thumb, hand breadth and breadth to crotches II through IV. The breadths, as a whole, tend to show slightly greater mean differences than do the lengths. Explanation for this may lie in the fact that breadth measurements include soft tissue and muscle mass, factors which are likely to be affected by muscle development through preferential hand usage.

Only three dimensions show slight differences favoring the left over the right hand values: the height of metacarpal II, and height of the proximal and middle phalanges of digit II. It is curious that the three major components of digit II show greater average left hand values, but that the total height of the digit from baseline to fleshy tip evidences the reverse pattern. Whether these trends are due to certain peculiarities in the present sample, or whether they are indicative of a characteristic universal pattern is not clear. At present, no similar data are available for comparison.

On a subject-by-subject basis, it was found that between 55 and 65 percent of the present sample contributed to the trend of greater overall right hand size. In terms of the long bones of the extremities, Schultz (ref. 13) has found a similar pattern. In a comparison of absolute size between left and right radii and humeri on a sample of 162 white male skeletons, he found that 66 percent of his sample favored the right side. In order to establish some relative measure of the difference, Schultz computed the actual differences between the sides as a percentage of the smaller of the two values. He concluded that, on the average, the percentage difference between the left and right upper limb bones was on the order of 1 to 2 percent. A similar approach to the present

TABLE XII
Right Hand Minus Left Hand Comparisons (in mm.)
Breadths

	\bar{x} Right	\bar{x} Left	\bar{x} Diff.	S.D. Diff.	S.E. Diff.	t^*
27. HAND BREADTH						
20. Wrist Breadth	91.01 70.25	89.94 69.96	1.07 0.29	1.73 2.64	.109 .166	9.82 1.75
28. Breadth Base Digit I	24.63	23.75	0.88	1.32	.083	10.60
26. Thickness Interphalangeal Knuckle I	23.03	22.75	0.28	0.82	.052	5.38
29. Breadth Base Digit II	23.03	22.93	0.10	0.78	.049	2.04
30. Breadth Proximal Knuckle II	22.06	21.69	0.37	0.68	.043	8.60
31. Breadth Distal Knuckle II	19.30	18.76	0.54	0.70	.044	12.27
32. Breadth Base Digit III	21.30	23.17	0.13	0.81	.051	2.55
33. Breadth Proximal Knuckle III	22.14	21.58	0.56	0.73	.046	12.17
34. Breadth Distal Knuckle III	19.03	18.51	0.52	0.67	.042	12.38
35. Breadth Base Digit IV	19.50	18.98	0.52	1.01	.063	8.25
36. Breadth Proximal Knuckle IV	20.59	20.26	0.33	0.69	.043	7.67
37. Breadth Distal Knuckle IV	17.95	17.62	0.33	0.64	.040	8.25
38. Breadth Base Digit V	18.80	18.15	0.65	0.88	.055	11.82
39. Breadth Proximal Knuckle V	18.16	17.84	0.32	0.70	.044	7.27
40. Breadth Distal Knuckle V	16.86	16.67	0.19	0.68	.043	4.42
41. Vert. Baseline to Crotch I	98.60	98.09	0.51	3.46	.218	2.34
42. Vert. Baseline to Crotch II	65.40	63.80	1.60	1.91	.120	13.33
43. Vert. Baseline to Crotch III	42.06	40.55	1.51	1.67	.105	14.38
44. Vert. Baseline to Crotch IV	20.58	19.44	1.14	1.43	.090	12.67

* For an N of 253, any t value greater than 2.59 is statistically significant at the 1% level of confidence.

hand data yielded comparable results. The mean percentage difference for hand length, for example, was computed as 0.28, and for hand breadth, 1.19.

Although the majority of dimensions show small mean differences between left and right hands, the actual t values, computed by dividing the difference between the means by the standard error of the difference, indicate that, on the whole, these differences are statistically significant at the 1% level. The magnitude of the t values is a function of two factors, the consistency of the trend toward greater right hand values and the relatively small variation in the range of differences.

A comparison of the coefficients of variation between the two hands provides further comment on right and left hand differences. Although the differences are small, an interesting pattern does emerge in a comparison of Tables VI through IX. With only one exception, the length dimensions of the right hand show consistently larger coefficients of variation (i. e., greater relative variability) than the left hand. Conversely, a comparison of the breadth dimensions shows the reverse pattern with most of the left hand breadths evidencing greater variability than the right. The explanation behind this pattern is not immediately apparent. It is possible that the asymmetries between the right and left hand may bear some relationship, but further explanation of this pattern is not possible until more extensive, comparative data are made available.

The computation of correlation coefficients between the 44 left hand and right hand dimensions was executed in an attempt to determine the degree of interrelationship between hands (see Table XIII). As expected, the overall magnitude of the r 's was consistently high indicating a fair degree of predictability from one hand to the other. In Table XIII, the standard error of estimate (S. E. est.) indicates the range of error to be expected when the value for a particular left hand dimension is predicted from a known value for the corresponding right hand. This statistic is a function of the size of r and the standard deviation of the predicted variable. Computation is accomplished by multiplying the S.D. of the dependent variable (the variable to be predicted) by the square root of $(1 - r^2)$. On the whole, as Table XIII indicates, most length values for the left hand can be predicted from known values for the right within a range to be expected on the basis of measuring error alone. Prediction of some of the breadth values, however, can be accomplished only within a wider range of error.

Some consideration was given to the reasons behind the particular sequence of ranking in Table XIII. Why should the lengths rank higher in the inter-hand correlations than most of the breadths? This question was touched upon earlier in the discussion of the mean correlations per dimension. A coefficient of correlation is in part a function of the means and standard deviations of the two variables being treated. Thus the coefficient of variation may provide some clue as to the size of r and the subsequent ranking of all 44 inter-hand correlations. The rank order correlation coefficients* between the rank of inter-hand r values and the rank of the C. V. 's (in this case, those for the right hand) was computed to be 0.731, indicating a high degree of interdependence.

* The formula for a rank order correlation is $1 - \frac{6(\sum D^2)}{N(N^2 - 1)}$

where D equals the difference between the ranks of the two items and N equals the number of rankings.

TABLE XIII
Coefficients of Correlation Between Left and Right Hands
Ranked by Size of \bar{r}

Dimension	\bar{r}	S. E. est*	C. V. %**	Dimension	\bar{r}	S. E. est.	* C. V. %**
9. Ht. Tip III HAND LENGTH	.967	2.08	4.28	17. Ht. Proximal Phalanx V	.826	3.56	5.68
8. Ht. Middle Phalanx III	.960	2.06	4.46	22. Ht. Metacarpal I	.808	1.94	5.42
2. Ht. Proximal Phalanx II	.957	1.79	4.65	15. Ht. Crotch IV	.805	2.96	5.21
7. Ht. Proximal Phalanx III	.955	1.81	4.50	34. Breadth Distal Knuckle III	.783	.66	5.31
4. Ht. Tip II	.955	2.37	4.42	20. Wrist Breadth	.781	2.63	5.44
3. Ht. Middle Phalanx II	.949	2.30	4.62	33. Breadth Proximal Knuckle III	.780	.71	4.79
14. Ht. Tip IV	.946	2.65	4.47	37. Breadth Distal Knuckle IV	.780	.62	5.24
13. Ht. Middle Phalanx IV	.938	2.56	4.68	30. Breadth Proximal Knuckle II	.776	.66	4.53
6. Ht. Metacarpal III	.933	1.51	4.66	43. Vert. Baseline to Crotch III	.772	1.63	5.71
12. Ht. Proximal Phalanx IV	.914	2.48	4.78	38. Breadth Base Digit V	.770	.87	6.81
5. Ht. Crotch II	.910	1.97	4.41	41. Vert. Baseline to Crotch I	.767	3.45	4.75
24. Ht. Tip I	.910	2.33	4.69	39. Breadth Proximal Knuckle IV	.763	.69	5.56
27. HAND BREADTH	.906	1.72	4.30	16. Ht. Metacarpal V	.763	3.16	6.45
10. Ht. Crotch III	.900	2.18	4.60	31. Breadth Distal Knuckle II	.761	.71	5.08
1. Ht. Metacarpal II	.897	1.94	4.91	36. Breadth Proximal Knuckle IV	.760	.68	4.56
23. Ht. Proximal Phalanx I	.884	2.18	5.20	25. Ht. Crotch I	.760	3.99	10.24
19. Ht. Tip V	.873	3.92	5.22	21. Ht. Meas. Hand Breadth	.752	3.43	6.90
11. Ht. Metacarpal IV	.861	2.21	5.14	26. Thickness Interphlg. Knuckle I	.750	.79	5.08
18. Ht. Middle Phalanx V	.861	3.77	5.56	40. Breadth Distal Knuckle V	.738	.65	5.63
29. Breadth Base Digit II	.849	.78	5.86	35. Breadth Base Digit IV	.736	.92	7.33
42. Vert. Baseline to Crotch II	.835	1.94	4.94	28. Breadth Base Digit I	.715	1.12	7.55
32. Breadth Base Digit III	.832	.79	6.34	44. Vert. Baseline Crotch IV	.650	1.38	7.72

* S. E. est (in mm.) for the prediction of the left from the right hand.

** C. V. for the right hand from Tables II and III.

SECTION V

SUMMARY

As stated at the outset, the main purpose of this report has been the provision of basic data on the roentgenographic anthropometry of the hand. Means, standard deviations and percentiles have been provided on 44 dimensions for both the left and right hands. Complete intercorrelation matrices relating the total list of dimensions have also been included. Analysis of the summary statistics led to the following conclusions:

1. In over 50 percent of the sample, the length of the fourth digit exceeded that of the second, lending support to findings reported in previous studies.
2. The right hand tended to be slightly larger in both length and breadth dimensions than the left. The majority of differences were statistically significant at the 1% level of confidence.
3. The right hand evidenced slightly greater variability in lengths and less in breadths than did the left hand.
4. Inter-hand correlations on a dimension by dimension basis demonstrated a high degree of predictability from one hand to the other. The ranking of the r values from large to small appeared to be related to the relative degree of variability (C. V.) per dimension.
5. Length dimensions of the fourth and third digits for both left and right hands showed the highest average correlations with all other dimensions. Finger breadths and one length, the height of crotch I, showed the lowest average interrelationships.
6. The highest correlations noted in the complete intercorrelation matrices occurred between the length dimensions of digits II through V and their respective components.
7. Hand breadth and the distance from the vertical baseline to crotches II and III were the only breadths which evidenced moderate to high coefficients of correlation with any of the lengths.

In any future application of the data included in this report, it is recommended that particular attention be paid to the indicated differences between the two hands, and to a consideration of the implications suggested in the entire range of intercorrelations.

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APPENDIX I

Index of Hand Dimensions

<u>Dimension</u>	<u>Number</u>
Breadth at Base of Digit I	28
Breadth at Base of Digit II	29
Breadth at Base of Digit III	32
Breadth at Base of Digit IV	35
Breadth at Base of Digit V	38
Breadth of Distal Knuckle II	31
Breadth of Distal Knuckle III	34
Breadth of Distal Knuckle IV	37
Breadth of Distal Knuckle V	40
Breadth of Proximal Knuckle II	30
Breadth of Proximal Knuckle III	33
Breadth of Proximal Knuckle IV	36
Breadth of Proximal Knuckle V	39
Hand Breadth	27
Height of Crotch I	25
Height of Crotch II	5
Height of Crotch III	10
Height of Crotch IV	15
Height of Measured Hand Breadth	21
Height of Metacarpal I	22
Height of Metacarpal II	1
Height of Metacarpal III	6
Height of Metacarpal IV	11
Height of Metacarpal V	16
Height of Middle Phalanx II	3
Height of Middle Phalanx III	8
Height of Middle Phalanx IV	13
Height of Middle Phalanx V	18
Height of Proximal Phalanx I	23
Height of Proximal Phalanx II	2
Height of Proximal Phalanx III	7
Height of Proximal Phalanx IV	12
Height of Proximal Phalanx V	17
Height of Tip I	24
Height of Tip II	4
Height of Tip III	9
Height of Tip IV	14
Height of Tip V	19
Thickness of Interphalangeal Knuckle I	26
Wrist Breadth	20
Vertical Baseline to Crotch I	41
Vertical Baseline to Crotch II	42
Vertical Baseline to Crotch III	43
Vertical Baseline to Crotch IV	44

APPENDIX II

INTERCORRELATION MATRICES, RIGHT AND LEFT HANDS

	1	2	3	4	5	6	7	8	9	
1 Ht. Metacarpal II		.919	.926	.898	.855	.863	.864	.843	.824	.71
2 Ht. Proximal Phalanx II	.919		.947	.928	.829	.842	.884	.878	.861	.71
3 Ht. Middle Phalanx II	.926	.947		.980	.870	.869	.924	.936	.923	.81
4 Ht. Tip II	.898	.928	.980		.860	.855	.911	.925	.930	.81
5 Ht. Crotch II	.855	.829	.870	.860		.865	.880	.872	.863	.81
6 Ht. Metacarpal III	.863	.842	.869	.855	.865		.950	.928	.911	.81
7 Ht. Proximal Phalanx III	.864	.884	.924	.911	.880	.950		.980	.963	.81
8 Ht. Middle Phalanx III	.843	.878	.936	.925	.872	.928	.980		.979	.81
9 Ht. Tip III - HAND LENGTH	.824	.861	.923	.930	.863	.911	.963	.979		.81
10 Ht. Crotch III	.751	.756	.809	.808	.888	.881	.888	.879	.872	
11 Ht. Metacarpal IV	.700	.731	.762	.754	.770	.901	.894	.871	.859	.81
12 Ht. Proximal Phalanx IV	.738	.793	.833	.829	.816	.906	.939	.930	.921	.91
13 Ht. Middle Phalanx IV	.733	.797	.855	.853	.815	.892	.937	.948	.940	.81
14 Ht. Tip IV	.719	.784	.848	.860	.804	.878	.924	.939	.944	.81
15 Ht. Crotch IV	.573	.625	.680	.685	.745	.789	.796	.790	.796	.91
16 Ht. Metacarpal V	.514	.577	.610	.610	.634	.761	.757	.742	.739	.81
17 Ht. Proximal Phalanx V	.593	.675	.715	.722	.704	.803	.831	.823	.823	.84
18 Ht. Middle Phalanx V	.599	.684	.739	.750	.710	.798	.834	.840	.844	.82
19 Ht. Tip V	.575	.658	.720	.747	.674	.761	.801	.810	.824	.81
20 Wrist Breadth	.204	.257	.264	.295	.270	.336	.355	.364	.363	.33
21 Ht. Meas. Hand Breadth	.475	.559	.588	.594	.606	.728	.728	.714	.712	.77
22 Ht. Metacarpal I	.598	.645	.666	.647	.626	.620	.672	.661	.636	.61
23 Ht. Proximal Phalanx I	.698	.761	.798	.793	.704	.710	.779	.780	.769	.67
24 Ht. Tip I	.697	.767	.817	.829	.721	.718	.794	.800	.805	.69
25 Ht. Crotch I	.541	.461	.499	.469	.507	.377	.407	.399	.390	.36
26 Thick. Interphalangeal Knuckle I	.304	.353	.382	.406	.395	.344	.392	.406	.426	.34
27 HAND BREADTH	.464	.484	.509	.525	.475	.527	.553	.554	.559	.43
28 Breadth Base Digit I	.148	.162	.191	.206	.208	.213	.224	.229	.225	.21
29 Breadth Base Digit II	.251	.253	.254	.269	.246	.276	.287	.280	.269	.27
30 Breadth Proximal Knuckle II	.311	.302	.342	.364	.336	.334	.351	.354	.360	.32
31 Breadth Distal Knuckle II	.211	.250	.282	.322	.302	.278	.305	.315	.340	.30
32 Breadth Base Digit III	.234	.230	.246	.260	.266	.298	.312	.315	.306	.27
33 Breadth Proximal Knuckle III	.355	.341	.376	.394	.397	.424	.445	.455	.450	.37
34 Breadth Distal Knuckle III	.246	.255	.295	.333	.363	.344	.376	.381	.409	.35
35 Breadth Base Digit IV	.119	.118	.153	.167	.240	.218	.227	.235	.222	.30
36 Breadth Proximal Knuckle IV	.229	.213	.235	.242	.280	.287	.279	.296	.291	.26
37 Breadth Distal Knuckle IV	.238	.250	.262	.293	.332	.307	.320	.316	.332	.30
38 Breadth Base Digit V	.066	.082	.091	.120	.197	.163	.155	.160	.167	.22
39 Breadth Proximal Knuckle V	.146	.148	.170	.191	.219	.225	.207	.222	.237	.22
40 Breadth Distal Knuckle V	.176	.207	.225	.262	.276	.250	.264	.274	.294	.25
41 Vert. Baseline Crotch I	.426	.444	.436	.456	.405	.447	.466	.461	.455	.33
42 Vert. Baseline Crotch II	.319	.382	.405	.434	.431	.506	.522	.525	.532	.45
43 Vert. Baseline Crotch III	.195	.280	.317	.358	.379	.405	.426	.431	.445	.42
44 Vert. Baseline Crotch IV	.090	.190	.218	.262	.287	.295	.311	.308	.325	.33

Intercorrelation Matrix, Right Hand

8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
.843	.824	.751	.700	.738	.733	.719	.573	.514	.593	.599	.575	.204	.475	.598	.698	.697
.878	.861	.756	.731	.793	.797	.784	.625	.577	.675	.684	.658	.257	.559	.645	.761	.767
.936	.923	.809	.762	.833	.855	.848	.680	.610	.715	.739	.720	.264	.588	.666	.798	.817
.925	.930	.808	.754	.829	.853	.860	.685	.610	.722	.750	.747	.295	.594	.647	.793	.829
.872	.863	.888	.770	.816	.815	.804	.745	.634	.704	.710	.674	.270	.606	.626	.704	.721
.928	.911	.881	.901	.906	.892	.878	.789	.761	.803	.798	.761	.336	.728	.620	.710	.718
.980	.963	.888	.894	.939	.937	.924	.796	.757	.831	.834	.801	.355	.728	.672	.779	.794
	.979	.879	.871	.930	.948	.939	.790	.742	.823	.840	.810	.364	.714	.661	.780	.800
.979		.872	.859	.921	.940	.944	.796	.739	.823	.844	.824	.363	.712	.636	.769	.805
.879	.872		.887	.912	.896	.886	.900	.800	.845	.839	.813	.338	.770	.610	.678	.697
.871	.859	.887		.963	.934	.915	.882	.910	.916	.895	.842	.393	.874	.603	.672	.685
.930	.921	.912	.963		.980	.963	.883	.881	.925	.918	.878	.394	.852	.650	.732	.750
.948	.940	.896	.934	.980		.982	.864	.851	.909	.921	.885	.387	.826	.645	.746	.768
.939	.944	.886	.915	.963	.982		.861	.836	.901	.920	.897	.406	.816	.625	.739	.780
.790	.796	.900	.882	.883	.864	.861		.899	.916	.897	.865	.362	.888	.562	.629	.657
.742	.739	.800	.910	.881	.851	.836	.899		.963	.924	.868	.333	.961	.553	.609	.621
.823	.823	.845	.916	.925	.909	.901	.916	.963		.977	.932	.335	.954	.612	.698	.719
.840	.844	.839	.895	.918	.921	.920	.897	.924	.977		.960	.348	.926	.608	.708	.739
.810	.824	.813	.842	.878	.885	.897	.865	.868	.932	.960		.340	.871	.598	.697	.746
.364	.363	.338	.393	.394	.387	.406	.362	.333	.335	.348	.340		.323	.203	.269	.287
.714	.712	.770	.874	.852	.826	.816	.888	.961	.954	.926	.871	.323		.531	.596	.612
.661	.636	.610	.603	.650	.645	.625	.562	.553	.612	.608	.598	.203	.531		.904	.863
.780	.769	.678	.672	.732	.746	.739	.629	.609	.698	.708	.697	.269	.596	.904		.958
.800	.805	.697	.685	.750	.768	.780	.657	.621	.719	.739	.746	.287	.612	.863	.958	
.399	.390	.360	.222	.257	.281	.277	.176	.093	.175	.184	.205	-.309	.062	.304	.370	.388
.406	.426	.341	.316	.367	.373	.399	.306	.257	.304	.337	.348	.416	.248	.327	.400	.466
.554	.559	.430	.500	.530	.539	.565	.378	.334	.383	.413	.406	.616	.301	.303	.399	.441
.229	.225	.212	.238	.236	.234	.248	.262	.216	.234	.226	.236	.465	.204	.249	.268	.265
.280	.269	.279	.287	.290	.279	.303	.317	.236	.237	.240	.234	.530	.200	.168	.190	.208
.354	.360	.324	.341	.355	.350	.381	.333	.257	.277	.285	.293	.460	.238	.176	.254	.302
.315	.340	.300	.298	.321	.312	.358	.327	.265	.290	.290	.321	.428	.252	.170	.233	.309
.315	.306	.273	.316	.307	.307	.333	.319	.229	.242	.247	.257	.504	.197	.069	.151	.176
.455	.450	.370	.392	.416	.413	.447	.342	.276	.306	.326	.343	.531	.244	.201	.298	.330
.381	.409	.350	.357	.386	.371	.408	.353	.281	.312	.328	.356	.447	.269	.127	.180	.269
.235	.222	.301	.268	.258	.260	.289	.331	.217	.213	.225	.223	.570	.189	.065	.096	.121
.296	.291	.266	.251	.275	.286	.326	.242	.164	.174	.208	.232	.464	.134	.097	.158	.200
.316	.332	.302	.304	.320	.306	.353	.287	.217	.239	.264	.252	.441	.204	.117	.181	.247
.160	.167	.220	.182	.193	.189	.220	.275	.154	.160	.185	.216	.539	.127	.045	.097	.130
.222	.237	.228	.227	.231	.235	.282	.257	.179	.198	.253	.268	.496	.178	.022	.121	.173
.274	.294	.255	.258	.282	.280	.328	.287	.229	.255	.288	.320	.386	.238	.146	.192	.258
.461	.455	.338	.394	.426	.427	.446	.295	.253	.296	.317	.308	.651	.242	.342	.375	.394
.525	.532	.453	.563	.572	.569	.594	.478	.470	.494	.504	.492	.630	.440	.290	.380	.423
.431	.445	.422	.514	.523	.519	.553	.487	.490	.514	.531	.519	.595	.488	.275	.361	.416
.308	.325	.339	.407	.418	.408	.445	.476	.476	.510	.528	.510	.463	.528	.249	.324	.372

23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
.698	.697	.541	.304	.464	.148	.251	.311	.211	.234	.355	.246	.119	.229	.238	.066	.146
.761	.767	.461	.353	.484	.162	.253	.302	.250	.230	.341	.255	.118	.213	.250	.082	.148
.798	.817	.499	.382	.509	.191	.254	.342	.282	.246	.376	.295	.153	.235	.262	.091	.170
.793	.829	.469	.406	.525	.206	.269	.364	.322	.260	.394	.333	.167	.242	.293	.120	.191
.704	.721	.507	.395	.475	.208	.246	.336	.302	.266	.397	.363	.240	.280	.332	.197	.219
.710	.718	.377	.344	.527	.213	.276	.334	.278	.298	.424	.344	.218	.287	.307	.163	.225
.779	.794	.407	.392	.553	.224	.287	.351	.305	.312	.445	.376	.227	.279	.320	.155	.207
.780	.800	.399	.406	.554	.229	.280	.354	.315	.315	.455	.381	.235	.296	.316	.160	.222
.769	.805	.390	.426	.559	.225	.269	.360	.340	.306	.450	.409	.222	.291	.332	.167	.237
.678	.697	.360	.341	.430	.212	.279	.324	.300	.273	.370	.350	.301	.266	.302	.220	.228
.672	.685	.222	.316	.500	.238	.287	.341	.298	.316	.392	.357	.268	.251	.304	.182	.227
.732	.750	.257	.367	.530	.236	.290	.355	.321	.307	.416	.386	.258	.275	.320	.193	.231
.746	.768	.281	.373	.539	.234	.279	.350	.312	.307	.413	.371	.260	.286	.306	.189	.235
.739	.780	.277	.399	.565	.248	.303	.381	.358	.333	.447	.408	.289	.326	.353	.220	.282
.629	.657	.176	.306	.378	.262	.317	.333	.327	.319	.342	.353	.331	.242	.287	.275	.257
.609	.621	.093	.257	.334	.216	.236	.257	.265	.229	.276	.281	.217	.164	.217	.154	.179
.698	.719	.175	.304	.383	.234	.237	.277	.290	.242	.306	.312	.213	.174	.239	.160	.198
.708	.739	.184	.337	.413	.226	.240	.285	.290	.247	.326	.328	.225	.208	.264	.185	.253
.697	.746	.205	.348	.406	.236	.234	.293	.321	.257	.343	.356	.223	.232	.252	.216	.268
.269	.287	-.309	.416	.616	.465	.530	.460	.428	.504	.531	.447	.570	.464	.441	.539	.496
.596	.612	.062	.248	.301	.204	.200	.238	.252	.197	.244	.269	.189	.134	.204	.127	.178
.904	.863	.304	.327	.303	.249	.168	.176	.170	.069	.201	.127	.065	.097	.117	.045	.022
	.958	.370	.400	.399	.268	.190	.254	.233	.151	.298	.180	.096	.158	.181	.097	.121
.958		.388	.466	.441	.265	.208	.302	.309	.176	.330	.269	.121	.200	.247	.130	.173
.370	.388		.211	.120	-.132	-.050	.138	.119	.015	.151	.153	-.052	.093	.110	-.063	-.030
.400	.466	.211		.526	.294	.452	.581	.623	.390	.584	.579	.320	.495	.539	.431	.491
.399	.441	.120	.526		.393	.570	.633	.552	.599	.712	.583	.513	.621	.568	.505	.524
.268	.265	-.132	.294	.393		.472	.350	.331	.447	.323	.252	.483	.268	.264	.383	.239
.190	.208	-.050	.452	.570	.472		.639	.538	.735	.552	.478	.685	.528	.487	.647	.407
.254	.302	.138	.581	.633	.350	.639		.704	.600	.772	.654	.462	.658	.611	.505	.568
.233	.309	.119	.623	.552	.331	.538	.704		.477	.637	.778	.384	.540	.715	.483	.544
.151	.176	.015	.390	.599	.447	.735	.600	.477		.671	.509	.733	.580	.490	.641	.430
.298	.330	.151	.584	.712	.323	.552	.772	.637	.671		.703	.508	.767	.648	.555	.616
.180	.269	.153	.579	.583	.252	.478	.654	.778	.509	.703		.437	.606	.784	.497	.560
.096	.121	-.052	.320	.513	.483	.685	.462	.384	.733	.508	.437		.512	.447	.669	.386
.158	.200	.093	.495	.621	.268	.528	.658	.540	.580	.767	.606	.512		.612	.594	.686
.181	.247	.110	.539	.568	.264	.487	.611	.715	.490	.648	.784	.447	.612		.474	.591
.097	.130	-.063	.431	.505	.383	.647	.505	.483	.641	.555	.497	.669	.594	.474		.627
.121	.173	-.030	.491	.524	.239	.407	.568	.544	.430	.616	.560	.386	.686	.591	.627	
.192	.258	.091	.526	.480	.265	.460	.573	.725	.393	.575	.732	.387	.565	.730	.479	.641
.375	.394	-.129	.398	.760	.480	.503	.466	.432	.500	.543	.405	.411	.451	.417	.412	.413
.380	.423	-.004	.479	.910	.385	.505	.571	.551	.588	.667	.587	.520	.586	.561	.545	.534
.361	.416	-.064	.426	.768	.346	.426	.470	.488	.456	.519	.503	.491	.516	.499	.525	.540
.324	.372	-.097	.383	.506	.233	.273	.355	.385	.275	.355	.386	.262	.367	.388	.420	.515

29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
.251	.311	.211	.234	.355	.246	.119	.229	.238	.066	.146	.176	.426	.319	.195	.090
.253	.302	.250	.230	.341	.255	.118	.213	.250	.082	.148	.207	.444	.382	.280	.190
.254	.342	.282	.246	.376	.295	.153	.235	.262	.091	.170	.225	.436	.405	.317	.218
.269	.364	.322	.260	.394	.333	.167	.242	.293	.120	.191	.262	.456	.434	.358	.262
.246	.336	.302	.266	.397	.363	.240	.280	.332	.197	.219	.276	.405	.431	.379	.287
.276	.334	.278	.298	.424	.344	.218	.287	.307	.163	.225	.250	.447	.506	.405	.295
.287	.351	.305	.312	.445	.376	.227	.279	.320	.155	.207	.264	.466	.522	.426	.311
.280	.354	.315	.315	.455	.381	.235	.296	.316	.160	.222	.274	.461	.525	.431	.308
.269	.360	.340	.306	.450	.409	.222	.291	.332	.167	.237	.294	.455	.532	.445	.325
.279	.324	.300	.273	.370	.350	.301	.266	.302	.220	.228	.255	.338	.453	.422	.339
.287	.341	.298	.316	.392	.357	.268	.251	.304	.182	.227	.258	.394	.563	.514	.407
.290	.355	.321	.307	.416	.386	.258	.275	.320	.193	.231	.282	.426	.572	.523	.418
.279	.350	.312	.307	.413	.371	.260	.286	.306	.189	.235	.280	.427	.569	.519	.408
.303	.381	.358	.333	.447	.408	.289	.326	.353	.220	.282	.328	.446	.594	.553	.445
.317	.333	.327	.319	.342	.353	.331	.242	.287	.275	.257	.287	.295	.478	.487	.476
.236	.257	.265	.229	.276	.281	.217	.164	.217	.154	.179	.229	.253	.470	.490	.476
.237	.277	.290	.242	.306	.312	.213	.174	.239	.160	.198	.255	.296	.494	.514	.510
.240	.285	.290	.247	.326	.328	.225	.208	.264	.185	.253	.288	.317	.504	.531	.528
.234	.293	.321	.257	.343	.356	.223	.232	.252	.216	.268	.320	.308	.492	.519	.510
.530	.460	.428	.504	.531	.447	.570	.464	.441	.539	.496	.386	.651	.630	.595	.463
.200	.238	.252	.197	.244	.269	.189	.134	.204	.127	.178	.238	.242	.440	.488	.528
.168	.176	.170	.069	.201	.127	.065	.097	.117	.045	.022	.146	.342	.290	.275	.249
.190	.254	.233	.151	.298	.180	.096	.158	.181	.097	.121	.192	.375	.380	.361	.324
.208	.302	.309	.176	.330	.269	.121	.200	.247	.130	.173	.258	.394	.423	.416	.372
.050	.138	.119	.015	.151	.153	-.052	.093	.110	-.063	-.030	.091	-.129	-.004	-.064	-.097
.452	.581	.623	.390	.584	.579	.320	.495	.539	.431	.491	.526	.398	.479	.426	.383
.570	.633	.552	.599	.712	.583	.513	.621	.568	.505	.524	.480	.760	.910	.768	.506
.472	.350	.331	.447	.323	.252	.483	.268	.264	.383	.239	.265	.480	.385	.346	.233
.639	.639	.538	.735	.552	.478	.685	.528	.487	.647	.407	.460	.503	.505	.426	.273
.639		.704	.600	.772	.654	.462	.658	.611	.505	.568	.573	.466	.571	.470	.355
.538	.704		.477	.637	.778	.384	.540	.715	.483	.544	.725	.432	.551	.488	.385
.735	.600	.477		.671	.509	.733	.580	.490	.641	.430	.393	.500	.588	.456	.275
.552	.172	.637	.671		.703	.508	.767	.648	.555	.616	.575	.543	.667	.519	.355
.178	.654	.778	.509	.703		.437	.606	.784	.497	.560	.732	.405	.587	.503	.386
.585	.462	.384	.733	.508	.437		.512	.447	.669	.386	.387	.411	.520	.491	.262
.528	.658	.540	.580	.767	.606	.512		.612	.594	.686	.565	.451	.586	.516	.367
.187	.611	.715	.490	.648	.784	.447	.612		.474	.591	.730	.417	.561	.499	.388
.47	.505	.483	.641	.555	.497	.669	.594	.474		.627	.479	.412	.545	.525	.420
.107	.568	.544	.430	.616	.560	.386	.686	.591	.627		.641	.413	.534	.540	.515
.160	.573	.725	.393	.575	.732	.387	.565	.730	.479	.641		.333	.493	.478	.432
.603	.466	.432	.500	.543	.405	.411	.451	.417	.412	.413	.333		.682	.578	.410
.605	.571	.551	.588	.667	.587	.520	.586	.561	.545	.534	.493	.682		.905	.668
.626	.470	.488	.456	.519	.503	.491	.516	.499	.525	.540	.478	.578	.905		.824
.73	.355	.385	.275	.355	.386	.262	.367	.388	.420	.515	.432	.410	.668	.824	

	1	2	3	4	5	6	7	8	9	10
1 Ht. Metacarpal II		.954	.922	.893	.840	.856	.835	.816	.801	.716
2 Ht. Proximal Phalanx II	.954		.980	.957	.864	.878	.908	.901	.891	.774
3 Ht. Middle Phalanx II	.922	.980		.979	.862	.863	.911	.923	.918	.786
4 Ht. Tip II	.893	.957	.979		.844	.838	.894	.915	.925	.773
5 Ht. Crotch II	.840	.864	.862	.844		.843	.844	.844	.834	.866
6 Ht. Metacarpal III	.856	.878	.863	.838	.843		.950	.925	.902	.861
7 Ht. Proximal Phalanx III	.835	.908	.911	.894	.844	.950		.976	.958	.855
8 Ht. Middle Phalanx III	.816	.901	.923	.915	.844	.925	.976		.982	.862
9 Ht. Tip III - HAND LENGTH	.801	.891	.918	.925	.834	.902	.958	.982		.851
10 Ht. Crotch III	.716	.774	.786	.773	.866	.861	.855	.862	.851	
11 Ht. Metacarpal IV	.647	.715	.721	.703	.734	.901	.872	.856	.832	.857
12 Ht. Proximal Phalanx IV	.695	.795	.812	.799	.778	.902	.933	.928	.910	.878
13 Ht. Middle Phalanx IV	.691	.803	.832	.827	.782	.884	.928	.946	.934	.876
14 Ht. Tip IV	.688	.800	.834	.842	.781	.874	.922	.944	.946	.868
15 Ht. Crotch IV	.539	.622	.649	.634	.732	.784	.778	.781	.768	.884
16 Ht. Metacarpal V	.438	.527	.555	.533	.590	.739	.730	.716	.695	.760
17 Ht. Proximal Phalanx V	.530	.648	.679	.664	.673	.790	.811	.809	.793	.817
18 Ht. Middle Phalanx V	.537	.664	.708	.701	.677	.782	.813	.829	.816	.821
19 Ht. Tip V	.551	.676	.719	.731	.690	.785	.812	.832	.831	.818
20 Wrist Breadth	.227	.282	.297	.327	.272	.354	.394	.397	.404	.326
21 Ht. Meas. Hand Breadth	.392	.493	.520	.508	.542	.691	.686	.675	.652	.713
22 Ht. Metacarpal I	.551	.595	.618	.611	.586	.594	.609	.622	.609	.551
23 Ht. Proximal Phalanx I	.626	.710	.744	.750	.654	.657	.704	.731	.731	.627
24 Ht. Tip I	.656	.741	.777	.806	.689	.696	.748	.776	.792	.669
25 Ht. Crotch I	.591	.545	.541	.518	.519	.403	.381	.392	.390	.358
26 Thick. Interphalangeal Knuckle I	.317	.359	.375	.413	.432	.385	.404	.413	.439	.382
27 HAND BREADTH	.433	.471	.491	.507	.456	.531	.568	.571	.575	.443
28 Breadth Base Digit I	.188	.223	.251	.269	.284	.301	.316	.327	.317	.312
29 Breadth Base Digit II	.250	.261	.263	.268	.279	.314	.303	.312	.311	.302
30 Breadth Proximal Knuckle II	.296	.323	.348	.363	.350	.357	.363	.372	.384	.323
31 Breadth Distal Knuckle II	.338	.373	.404	.442	.385	.387	.418	.441	.459	.379
32 Breadth Base Digit III	.185	.198	.205	.210	.241	.301	.287	.299	.308	.236
33 Breadth Proximal Knuckle III	.257	.291	.313	.332	.340	.366	.388	.412	.425	.325
34 Breadth Distal Knuckle III	.295	.324	.350	.381	.386	.384	.418	.430	.455	.366
35 Breadth Base Digit IV	.090	.124	.131	.135	.250	.211	.218	.242	.246	.293
36 Breadth Proximal Knuckle IV	.264	.274	.277	.288	.345	.332	.329	.344	.358	.291
37 Breadth Distal Knuckle IV	.228	.258	.275	.312	.368	.327	.348	.353	.366	.334
38 Breadth Base Digit V	.096	.140	.158	.163	.239	.212	.229	.243	.240	.270
39 Breadth Proximal Knuckle V	.229	.265	.291	.321	.319	.333	.341	.356	.377	.318
40 Breadth Distal Knuckle V	.189	.233	.253	.302	.305	.289	.318	.334	.356	.309
41 Vert. Baseline Crotch I	.333	.362	.371	.389	.346	.413	.445	.444	.450	.326
42 Vert. Baseline Crotch II	.213	.281	.319	.342	.338	.442	.478	.481	.480	.390
43 Vert. Baseline Crotch III	.164	.253	.297	.320	.323	.395	.439	.448	.451	.402
44 Vert. Baseline Crotch IV	.068	.172	.204	.207	.188	.255	.302	.306	.301	.284

Intercorrelation Matrix, Left Hand

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
.801	.716	.647	.695	.691	.688	.539	.438	.530	.537	.551	.227	.392	.551	.626	.656	.591
.891	.774	.715	.795	.803	.800	.622	.527	.648	.664	.676	.282	.493	.595	.710	.741	.545
.918	.786	.721	.812	.832	.834	.649	.555	.679	.708	.719	.297	.520	.618	.744	.777	.541
.925	.773	.703	.799	.827	.842	.634	.533	.664	.701	.731	.327	.508	.611	.750	.806	.518
.834	.866	.734	.778	.782	.781	.732	.590	.673	.677	.690	.272	.542	.586	.654	.689	.519
.902	.861	.901	.902	.884	.874	.784	.739	.790	.782	.785	.354	.691	.594	.657	.696	.403
.958	.855	.872	.933	.928	.922	.778	.730	.811	.813	.812	.394	.686	.609	.704	.748	.381
.982	.862	.856	.928	.946	.944	.781	.716	.809	.829	.832	.397	.675	.622	.731	.776	.392
	.851	.832	.910	.934	.946	.768	.695	.793	.816	.831	.404	.652	.609	.731	.792	.390
.851		.857	.878	.876	.868	.884	.760	.817	.821	.818	.326	.713	.551	.627	.669	.358
.832	.857		.950	.922	.898	.889	.902	.913	.888	.874	.380	.865	.566	.613	.653	.190
.910	.878	.950		.980	.966	.876	.865	.921	.914	.905	.399	.829	.591	.675	.718	.247
.934	.876	.922	.980		.983	.864	.833	.907	.921	.916	.410	.801	.605	.707	.750	.278
.946	.868	.898	.966	.983		.846	.806	.884	.904	.913	.442	.774	.588	.695	.754	.273
.768	.884	.889	.876	.864	.846		.895	.899	.880	.865	.359	.859	.547	.596	.636	.149
.595	.760	.902	.865	.833	.806	.895		.954	.914	.887	.321	.952	.550	.572	.601	.055
.793	.817	.913	.921	.907	.884	.899	.954		.975	.957	.348	.934	.590	.659	.692	.148
.816	.821	.888	.914	.921	.904	.880	.914	.975		.983	.363	.899	.593	.684	.719	.172
.831	.818	.874	.905	.916	.913	.865	.887	.957	.983		.385	.875	.590	.687	.742	.188
.404	.326	.380	.399	.410	.442	.359	.321	.348	.363	.385		.348	.278	.278	.350	.232
.552	.713	.865	.829	.801	.774	.859	.952	.934	.899	.875	.348		.500	.528	.563	.012
.509	.551	.566	.591	.605	.588	.547	.550	.590	.593	.590	.278	.500		.915	.872	.259
.731	.627	.613	.675	.707	.695	.596	.572	.659	.684	.687	.278	.528	.915		.952	.347
.792	.669	.653	.718	.750	.754	.636	.601	.692	.719	.742	.350	.563	.872	.952		.378
.390	.358	.190	.247	.278	.273	.149	.055	.148	.172	.188	.232	.012	.259	.347	.378	
.439	.382	.354	.380	.387	.416	.375	.283	.318	.333	.372	.556	.265	.285	.307	.416	.185
.575	.443	.484	.534	.552	.566	.411	.352	.405	.431	.459	.603	.323	.332	.373	.457	.136
.317	.312	.316	.333	.332	.335	.343	.313	.302	.311	.326	.475	.287	.340	.304	.322	.089
.311	.302	.283	.291	.289	.298	.327	.247	.235	.241	.260	.502	.215	.212	.184	.242	.031
.384	.323	.315	.344	.361	.382	.347	.254	.276	.293	.313	.511	.248	.241	.252	.324	.142
.459	.379	.347	.396	.414	.438	.375	.288	.338	.352	.392	.452	.278	.305	.331	.442	.223
.308	.236	.242	.259	.255	.270	.254	.171	.157	.171	.189	.423	.109	.121	.119	.185	.003
.425	.325	.330	.357	.381	.399	.349	.275	.286	.308	.337	.496	.244	.236	.229	.308	.108
.455	.366	.347	.387	.394	.427	.382	.308	.334	.344	.383	.498	.279	.283	.279	.385	.171
.246	.293	.216	.230	.247	.262	.315	.196	.176	.194	.216	.438	.126	.099	.083	.136	.035
.358	.291	.267	.284	.312	.341	.286	.203	.212	.232	.263	.494	.174	.164	.166	.248	.111
.366	.334	.345	.368	.378	.404	.357	.291	.321	.340	.377	.515	.295	.210	.218	.320	.072
.240	.270	.209	.231	.254	.267	.299	.216	.210	.249	.259	.475	.160	.131	.133	.188	.023
.377	.318	.331	.345	.374	.402	.370	.276	.314	.362	.394	.527	.284	.208	.229	.322	.050
.356	.309	.300	.333	.342	.379	.329	.282	.310	.326	.372	.506	.276	.200	.205	.318	.012
.450	.326	.393	.432	.432	.454	.342	.294	.338	.357	.379	.656	.280	.364	.341	.381	.208
.480	.390	.494	.520	.530	.546	.449	.463	.478	.489	.511	.599	.437	.296	.326	.404	.044
.451	.402	.508	.528	.544	.554	.499	.529	.548	.562	.574	.550	.531	.311	.342	.423	.065
.301	.284	.412	.412	.419	.410	.423	.480	.508	.513	.500	.379	.532	.237	.269	.315	.150

24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
656	.591	.317	.433	.188	.250	.296	.338	.185	.257	.295	.090	.264	.228	.096	.229	.189
741	.545	.359	.471	.223	.261	.323	.373	.198	.291	.324	.124	.274	.258	.140	.265	.233
777	.541	.375	.491	.251	.263	.348	.404	.205	.313	.350	.131	.277	.275	.158	.291	.253
806	.518	.413	.507	.269	.268	.363	.442	.210	.332	.381	.135	.288	.312	.163	.321	.302
689	.519	.432	.456	.284	.279	.350	.385	.241	.340	.386	.250	.345	.368	.239	.319	.305
696	.403	.385	.531	.301	.314	.357	.387	.301	.366	.384	.211	.332	.327	.212	.333	.289
748	.381	.404	.568	.316	.303	.363	.418	.287	.388	.418	.218	.329	.348	.229	.341	.318
776	.392	.413	.571	.327	.312	.372	.441	.299	.412	.430	.242	.344	.353	.243	.356	.334
792	.390	.439	.575	.317	.311	.384	.459	.308	.425	.455	.246	.358	.366	.240	.377	.356
669	.358	.382	.443	.312	.302	.323	.379	.236	.325	.366	.293	.291	.334	.270	.318	.309
653	.190	.354	.484	.316	.283	.315	.347	.242	.330	.347	.216	.267	.345	.209	.331	.300
718	.247	.380	.534	.333	.291	.344	.396	.259	.357	.387	.230	.284	.368	.231	.345	.333
750	.278	.387	.552	.332	.289	.361	.414	.255	.381	.394	.247	.312	.378	.254	.374	.342
754	.273	.416	.566	.335	.298	.382	.438	.270	.399	.427	.262	.341	.404	.267	.402	.379
636	.149	.375	.411	.343	.327	.347	.375	.254	.349	.382	.315	.286	.357	.299	.370	.329
601	.055	.283	.352	.313	.247	.254	.288	.171	.275	.308	.196	.203	.291	.216	.276	.282
692	.148	.318	.405	.302	.235	.276	.338	.157	.286	.334	.176	.212	.321	.259	.394	.372
719	.172	.333	.431	.311	.241	.293	.352	.171	.308	.344	.194	.232	.340	.475	.527	.506
742	.188	.372	.459	.326	.260	.313	.392	.189	.337	.383	.216	.263	.377	.210	.314	.310
350	.232	.556	.603	.475	.502	.511	.452	.423	.496	.498	.438	.494	.515	.249	.362	.326
563	.012	.265	.323	.287	.215	.248	.278	.109	.244	.279	.126	.174	.295	.160	.284	.276
872	.259	.285	.332	.340	.212	.241	.305	.121	.236	.283	.099	.164	.210	.131	.208	.200
952	.347	.307	.373	.304	.184	.252	.331	.119	.229	.279	.083	.166	.218	.133	.229	.205
378	.378	.416	.457	.322	.242	.324	.442	.185	.308	.385	.136	.248	.320	.188	.322	.318
416	.185	.561	.389	.506	.604	.647	.457	.621	.671	.466	.591	.619	.449	.576	.650	
457	.136	.561	.456	.553	.606	.556	.543	.640	.603	.471	.604	.566	.571	.603	.558	
322	.089	.389	.456	.475	.456	.390	.410	.440	.391	.389	.334	.339	.396	.341	.337	
242	.031	.506	.553	.475	.668	.509	.701	.594	.511	.640	.594	.512	.618	.505	.464	
324	.142	.604	.606	.456	.668	.642	.473	.806	.602	.427	.696	.635	.501	.633	.572	
442	.223	.647	.556	.390	.509	.642	.412	.597	.773	.404	.556	.686	.387	.558	.691	
185	.003	.457	.543	.410	.701	.473	.412	.504	.475	.708	.565	.398	.576	.432	.391	
308	.108	.621	.640	.440	.594	.806	.597	.504	.663	.514	.766	.645	.500	.663	.597	
385	.171	.671	.603	.391	.511	.602	.773	.475	.663	.486	.641	.784	.481	.645	.735	
136	.035	.466	.471	.389	.640	.427	.404	.708	.514	.486	.593	.483	.668	.447	.420	
248	.111	.591	.604	.334	.594	.696	.556	.565	.766	.641	.593	.668	.560	.692	.596	
320	.072	.619	.566	.339	.512	.635	.686	.398	.645	.784	.483	.668	.480	.692	.734	
188	.023	.449	.571	.396	.618	.501	.387	.576	.500	.481	.668	.560	.480	.602	.510	
322	.050	.576	.603	.341	.505	.633	.558	.432	.663	.645	.447	.692	.692	.602	.676	
318	.012	.650	.558	.337	.464	.572	.691	.391	.597	.735	.420	.596	.734	.510	.676	
381	.208	.392	.690	.536	.492	.450	.392	.432	.467	.419	.380	.450	.420	.390	.474	.432
404	.044	.495	.899	.436	.452	.492	.485	.503	.570	.563	.460	.540	.546	.597	.570	.582
423	.065	.440	.798	.405	.407	.440	.450	.365	.492	.514	.415	.485	.536	.564	.581	.552
315	.150	.250	.525	.311	.261	.297	.270	.140	.268	.325	.130	.254	.371	.389	.488	.406

30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
.296	.338	.185	.257	.295	.090	.264	.228	.096	.229	.189	.333	.213	.164	.068
.323	.373	.198	.291	.324	.124	.274	.258	.140	.265	.233	.362	.281	.253	.172
.348	.404	.205	.313	.350	.131	.277	.275	.158	.291	.253	.371	.319	.297	.204
.363	.442	.110	.332	.381	.135	.288	.312	.163	.321	.302	.389	.342	.320	.207
.350	.385	.241	.340	.386	.250	.345	.368	.239	.319	.305	.346	.338	.323	.188
.357	.387	.301	.366	.384	.211	.332	.327	.212	.333	.289	.413	.442	.395	.255
.363	.418	.287	.388	.418	.218	.329	.348	.229	.341	.318	.445	.478	.439	.302
.372	.441	.299	.412	.430	.242	.344	.353	.243	.356	.334	.444	.481	.448	.306
.384	.459	.308	.425	.455	.246	.358	.366	.240	.377	.356	.450	.480	.451	.301
.323	.379	.236	.325	.366	.293	.291	.334	.270	.318	.309	.326	.390	.402	.284
.315	.347	.242	.330	.347	.216	.267	.345	.209	.331	.300	.393	.494	.508	.412
.344	.396	.259	.357	.387	.230	.284	.368	.231	.345	.333	.432	.520	.528	.412
.361	.414	.255	.381	.394	.247	.312	.378	.254	.374	.342	.432	.530	.544	.419
.382	.438	.270	.399	.427	.262	.341	.404	.267	.402	.379	.454	.546	.554	.410
.347	.375	.254	.349	.382	.315	.286	.357	.299	.370	.329	.342	.449	.499	.423
.254	.288	.171	.275	.308	.196	.203	.291	.216	.276	.282	.294	.463	.529	.480
.276	.338	.157	.286	.334	.176	.212	.321	.259	.394	.372	.379	.511	.574	.500
.293	.352	.171	.308	.344	.194	.232	.340	.475	.527	.506	.656	.599	.550	.379
.313	.392	.189	.337	.383	.216	.263	.377	.210	.314	.310	.338	.478	.548	.508
.511	.452	.423	.496	.498	.438	.494	.515	.249	.362	.326	.357	.489	.562	.513
.248	.278	.109	.244	.279	.126	.174	.295	.160	.284	.276	.280	.437	.531	.532
.241	.305	.121	.236	.283	.099	.164	.210	.131	.208	.200	.364	.296	.311	.237
.252	.331	.119	.229	.279	.083	.166	.218	.133	.229	.205	.341	.326	.342	.269
.324	.442	.185	.308	.385	.136	.248	.320	.188	.322	.318	.381	.404	.423	.315
.142	.223	-.003	.108	.171	-.035	.111	.072	-.023	.050	.012	-.208	-.044	-.065	-.150
.604	.647	.457	.621	.671	.466	.591	.619	.449	.576	.650	.392	.495	.440	.250
.606	.556	.543	.640	.603	.471	.604	.566	.571	.603	.558	.690	.899	.798	.525
.456	.390	.410	.440	.391	.389	.334	.339	.396	.341	.337	.536	.436	.405	.311
.668	.509	.701	.594	.511	.640	.594	.512	.618	.505	.464	.492	.452	.409	.261
	.642	.473	.806	.602	.427	.696	.635	.501	.633	.572	.450	.492	.440	.297
.642		.412	.597	.773	.404	.556	.686	.387	.558	.691	.392	.485	.450	.270
.473	.412		.504	.475	.708	.565	.398	.576	.432	.391	.432	.503	.365	.140
.806	.597	.504		.663	.514	.766	.645	.500	.663	.597	.467	.570	.492	.268
.602	.773	.475	.663		.486	.641	.784	.481	.645	.735	.419	.563	.514	.325
.427	.404	.708	.514	.486		.593	.483	.668	.447	.420	.380	.460	.415	.130
.696	.556	.565	.766	.641	.593		.668	.560	.692	.596	.450	.540	.485	.254
.635	.686	.398	.645	.784	.483	.668		.480	.692	.734	.420	.546	.536	.371
.501	.387	.576	.500	.481	.668	.560	.480		.602	.510	.390	.597	.564	.389
.633	.558	.432	.663	.645	.447	.692	.692	.602		.676	.474	.570	.581	.488
.572	.691	.391	.597	.735	.420	.596	.734	.510	.676		.432	.582	.552	.406
.450	.392	.432	.467	.419	.380	.450	.420	.390	.474	.432		.627	.576	.404
.492	.485	.503	.570	.563	.460	.540	.546	.597	.570	.582	.627		.922	.633
.440	.450	.365	.492	.514	.415	.485	.536	.564	.581	.552	.576	.922		.774
.297	.270	.140	.268	.325	.130	.254	.371	.389	.488	.406	.404	.633	.774	

4

<p>Aerospace Medical Division, 6570th Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio Rpt No. AMRL-TDR-62-111. X-RAY ANTHROPOMETRY OF THE HAND. Final report, Sept 62, v + 36 pp., incl illus., tables, 14 refs. Unclassified report</p>	<p>UNCLASSIFIED</p> <ol style="list-style-type: none"> 1. Anthropology 2. Anthropometry 3. Hands 4. X-rays <p>I. AFSC Project 7184, Task 718408</p> <p>II. Behavioral Sciences Laboratory</p> <p>III. Contract AF 33(616)-6792</p> <p>IV. Antioch College, Yellow Springs, Ohio</p> <p>V. J. H. Vicinus</p> <p>VI. In ASTIA collection</p> <p>VII. Aval fr OTS \$1. 50</p> <p>UNCLASSIFIED</p>	<p>Aerospace Medical Division, 6570th Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio Rpt No. AMRL-TDR-62-111. X-RAY ANTHROPOMETRY OF THE HAND. Final report, Sept 62, v + 36 pp., incl illus., tables, 14 refs. Unclassified report</p> <p>A comprehensive descriptive summary of the X-ray anthropometry of the hand is presented. The 253 subjects chosen for measurement were selected to be representative of the Air Force population in hand length and hand breadth. Summary statistics for 24 lengths and 20 breadths for both the left and the right hands are presented. Also included in the report are complete intercorrelation matrices for both</p> <p>(over)</p>	<p>hands indicating the degree of inter-relationship between the 44 dimensions. Analysis of the data indicates that, in general, the right hand tends to be longer and broader than the left, the right hand also showing slightly greater variability in length and less variability in breadth than the left. The lowest correlations occur in the relationships between length and breadth dimensions, and the highest are to be found within the length dimensions of each of the 5 digits.</p>
<p>Aerospace Medical Division, 6570th Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio Rpt No. AMRL-TDR-62-111. X-RAY ANTHROPOMETRY OF THE HAND. Final report, Sept 62, v + 36 pp., incl illus., tables, 14 refs. Unclassified report</p>	<p>UNCLASSIFIED</p> <ol style="list-style-type: none"> 1. Anthropology 2. Anthropometry 3. Hands 4. X-rays <p>I. AFSC Project 7184, Task 718408</p> <p>II. Behavioral Sciences Laboratory</p> <p>III. Contract AF 33(616)-6792</p> <p>IV. Antioch College, Yellow Springs, Ohio</p> <p>V. J. H. Vicinus</p> <p>VI. In ASTIA collection</p> <p>VII. Aval fr OTS \$1. 50</p> <p>UNCLASSIFIED</p>	<p>UNCLASSIFIED</p>	<p>UNCLASSIFIED</p>

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